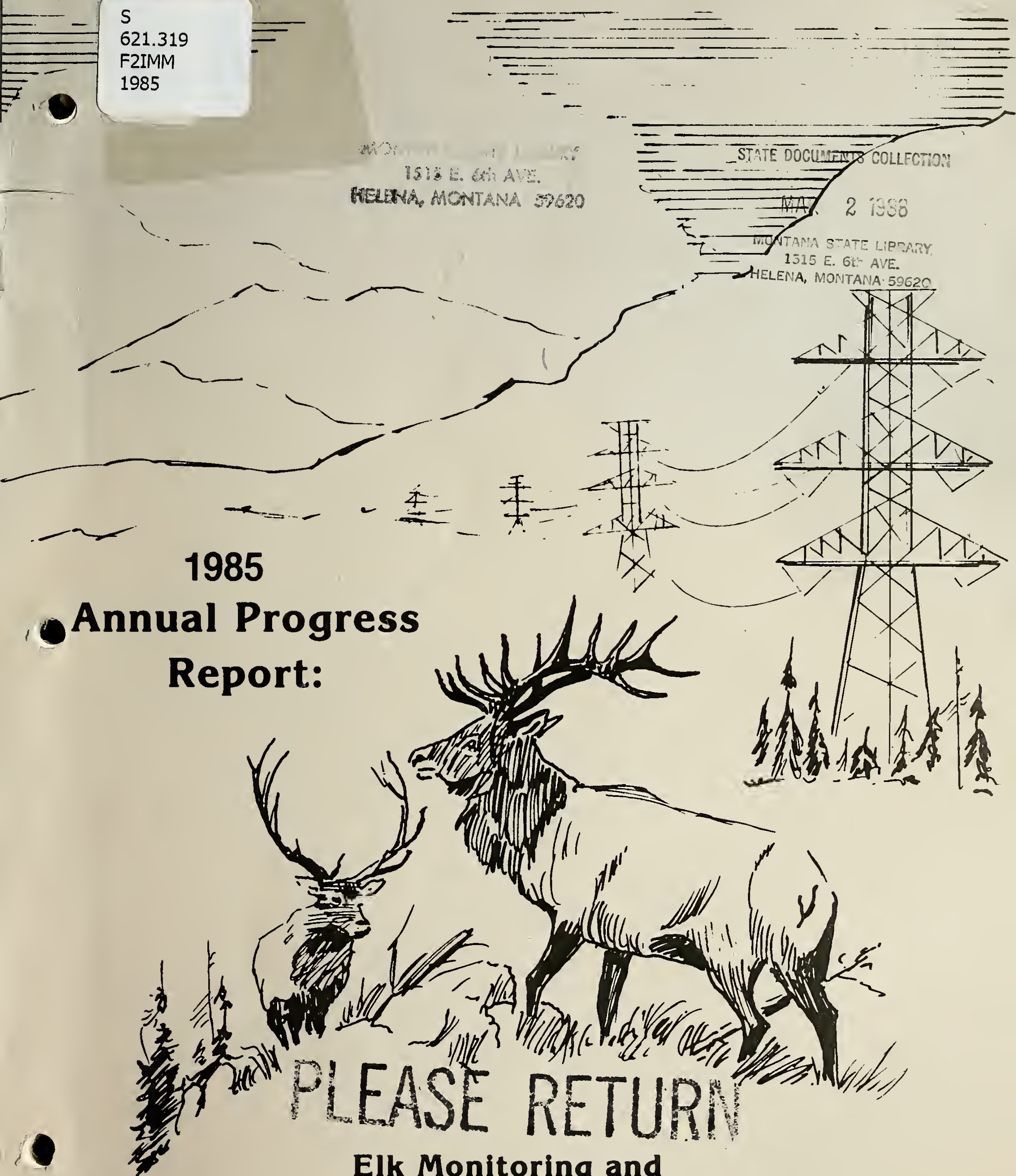

1985 Annual Progress Report:

Elk Monitoring and Mitigation Project along the BPA 500 KV Transmission Line

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Impact mitigation and monitoring of the BPA 500 KV Garrison-Taft transmission line - effects on elk security and hunter opportunity

Annual Progress Report for 1985

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Montana Department of Fish, Wildlife and Parks

Funded by:
Bonneville Power Administration
(Agreement No. DE-AI79-84-BP16380)

In cooperation with:
Lolo National Forest
Deerlodge National Forest
U.S. Bureau of Land Management
Montana Department of Natural Resources and Conservation

March, 1986

ACKNOWLEDGMENT

This study required the efforts, assistance, cooperation, and support of numerous individuals in the Montana Department of Fish, Wildlife, and Parks (DFWP) and the other involved agencies. Funding was provided by the Bonneville Power Administration (BPA). Supplemental funding for summer and fall relocation efforts in the DeBorgia area was provided by the Lolo National Forest (LNF). The Montana Department of Natural Resources and Conservation (DNRC), DFWP, BPA, LNF, Deerlodge National Forest, and Bureau of Land Management all participated in ongoing project planning and review. The "Introduction" and "Objectives" sections of this report were taken from the project's study plan which was drafted by Gary Hammond and Larry Thompson. Larry also provided the summary of waiver request information presented in this report. The University of Montana, Missoula, and Cooperative Wildlife Research Unit provided equipment and expertise. Aviation services were provided by Dave Rosenkranz of Hamilton Aviation and Pete Johnson of DFWP. Special thanks are extended to Russ Offerdahl for considerable field assistance, and to Quinn Prichard for graciously donating the cover artwork.

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INTRODUCTION

In November of 1982, a joint state-federal study team selected the Taft South Route for the Bonneville Power Administration's (BPA) Garrison West powerline project ("the Project"). The agencies were concerned with the potential wildlife impacts of the Taft South route, as this route crossed many miles of what was considered to be important elk summer-fall habitat: high, moist, forested mountain slopes including large areas of land a mile or more from existing roads, some of which had been designated as roadless areas in the RARE II evaluation. The joint state-federal analysis of the alternative routes for the Project concluded that although this route would minimize impacts to people it would pose the greatest risk of impact to fish, wildlife, and nonmotorized recreation.

The interagency study team concluded that an elk mitigation and monitoring study was necessary in part to document the various impacts to elk and secondly to mitigate for these impacts to the extent possible (USDA et al. 1983). Predicted impacts include the following:

(1) Impacts due to Construction Activity The State's impact analysis determined that powerline construction activity would have impacts upon elk populations similar to those documented for logging activities by the Cooperative Elk-Logging Study. The interagency study team concluded that it was not a worthwhile expenditure of resources to duplicate earlier study in an attempt to document these already well-known impacts. Also, the impacts of construction activity on elk populations, hunter opportunity, and hunting quality are short-term in comparison to other impacts and hence of lesser concern. Therefore, the study was not designed to document impacts due to construction activity.

(2) Impacts Due to Towers and Conductors The presence of towers and conductors would have a significant visual impact upon the quality of the hunting experience, but would probably not affect hunter opportunity or elk populations.

(3) Electrical Effects and Noise The effect of electrical fields and noise upon elk was not felt to be a major concern; however, the preliminary findings of the Boulder Elk Study indicate that there may be some response of elk to transmission line-related electrical fields and/or noise (Canfield 1984).

(4) Impacts Due to Cleared Right-of-way The presence of a cleared right-of-way would have a slight effect on elk habitat quality--possibly a beneficial effect--but this would not be significant because the amount of habitat affected is relatively small and spread over a relatively great length of line. Some visual impacts due to the right-of-way would affect hunting quality, and some hunting access in addition to that created by access roads would be provided. But the impacts of the cleared right-of-way were not thought to be a major concern.

(5) Impacts Due to New Access Roads Of greatest concern were the impacts of new access roads created as part of the Project (including upgrading of

existing low-quality roads to BPA standards). DNRC's draft report to the Board stated that:

> "...research has shown that increased road densities in elk habitat could render animals more vulnerable to hunting. This commonly causes more restrictive hunting regulations in the form of shorter seasons or hunting by permit only. Shorter seasons and permit hunting are unpopular with hunters and could decrease revenues available for wildlife management and local economies in the form of license fees and recreational expenditures. Elk license revenues in 1978 totaled $4.4 million in Montana (Lonner and Cada 1982). A conservative estimate of elk hunter spending is $45 per day, which contributes an additional $29 million to the State's economy each hunting season." (DNRC 1983, p. 34).

The principal anticipated long-term, direct impact of the Project on elk is the opening of previously unroaded security areas to hunters by line access roads. This leads in turn to (a) changes in elk distribution, (b) changes in habitat use patterns, (c) possible reduction in available security areas forcing animals into marginal habitats, (d) earlier harvest of bulls leading to a reduction in hunter opportunity, (e) lower ratios of bulls to adult cow elk, (f) more restrictive seasons or permit only hunting because of the reduction in the availability of bulls left to hunt. Most of these predicted impacts are a result of the loss of secure summer-fall habitat in areas crossed by transmission line access roads; hence the emphasis of the study on elk summer-fall security areas.

An anticipated secondary long-term impact of the Project is the opening up to timber harvest of areas that would otherwise not have been logged for years (or perhaps never) because of marginal economics and lack of haul roads. This logging, in areas that would otherwise be untouched, would cause additional impacts to wildlife (Montana DNRC 1983, p. 34).

OBJECTIVES

The specific objectives of this study are:

(1) To determine the effectiveness of the mitigation measures employed in the Garrison-Taft Project (USDA et al., 1983) to minimize impacts on elk;

(2) To determine the nature and magnitude of the impacts of the Project on elk summer-fall habitat use, distribution, use of security areas, and harvest, with emphasis on the adult male segment of the population;

(3) To identify and recommend protection for important elk security areas remaining in areas adjacent to the Project;

(4) To assess impacts of the Project on hunter opportunity and on hunters' perceptions of hunting as related to the transmission line, right-of-way, and road system;

(5) To reduce to the extent possible the net impacts of the Project on elk and elk hunter opportunity;

(6) To determine appropriate measures for offsetting unmitigated impacts. This will involve assessing Project-caused changes along the entire route and comparing these with documented impacts on elk and elk hunting within the study areas.

STUDY PLAN

A study plan was developed by the interagency study team in 1984, outlining tasks, methods, and schedules for meeting the study objectives. Specific tasks outlined in the study plan are:

1. Literature review
2. Map vegetation and habitat types
3. Develop analytical procedures and standard data forms
4. Collect data along elk pellet group transects
5. Summarize elk hunting regulations and harvest data
6. Assist with DNRC hunter opportunity study
7. Install and monitor car counters
8. Capture and collar elk
9. Monitor radio collars and map elk security areas
10. Determine fecal DAPA levels
11. Monitor construction and compliance with mitigation measures
12. Participate in Forest Service project planning
13. Participate in USFS Forest planning process
14. Implement road closures through participation in USFS travel planning process
15. Determine project impacts on elk and hunting opportunity
16. Determine magnitude of unmitigated impact
17. Recommend measures to offset unmitigated project impact
18. Prepare reports

Tasks are scheduled for completion by August 31, 1988. Study areas were selected, and data were collected along permanent, pellet group transects from August to October, 1983, prior to powerline construction (Elliott 1983). Pre-construction hunter surveys were also accomplished in 1983 (Allen 1984). Study activities resumed in March, 1984, when the project biologist was hired, and a report of study activities through December 1984 was prepared (Hammond et al. 1985). This report summarizes study progress from January through December 1985.

STUDY AREAS

The powerline corridor under consideration extends for about 156 miles between the Garrison and Taft substations in western Montana. Project impacts along the entire length of the corridor will be monitored and evaluated, in part by extrapolating the results of intensive monitoring on two study areas located at opposite ends of the corridor (Figure 1). These two study areas, referred to as Harvey-Eightmile and DeBorgia, represent the moisture and cover type extremes in summer-fall elk habitats that occur along the corridor. Both study areas are heavily forested, and include previously unroaded security areas that were crossed by the powerline corridor and associated new roads.

Harvey-Eightmile

The Harvey-Eightmile study area (Figure 2) is located in Granite County, approximately 11 miles west of Hall, Montana. General boundaries are lower Harvey Creek on the east, Harvey-Eightmile ridge trail on the south, Strawberry Mountain on the west, and Tyler Mountain and Lodgepole Spring on the north. Two major stream drainages, Tyler Creek and Eightmile Creek, flow northeasterly through the area into the Clark Fork River. Prominent peaks in the region include Sliderock Mountain (7820 feet), Golden Mountain (6634 feet), and East Hill (6150 feet), all of which are located immediately west of the study area. Forests in the *Pseudotsuga menziesii* and *Abies lasiocarpa* series dominate the vegetation cover (Pfister et al. 1977). The Harvey-Eightmile study area was divided into two separate zones for analysis purposes. The western half of the study area (sampled by transects 5-8) was previously roaded and includes a number of clearcuts; this was referred to as the cutover study zone. Conversely, the eastern half of the study area (sampled by transects 1-4 and 9-10) was previously non-roaded and was not clearcut; this was referred to as the uncut study zone.

In cooperation with this study, the USFS deferred the Harvey-Eightmile timber sale in the center of the Harvey-Eightmile study area for the duration of this study. Also, the USFS agreed to remove from consideration several blocks of the Brewster-Tyler-Genoa timber sale which would have impacted the study area. This will facilitate an analysis of powerline-related impacts without the confounding influences of logging activities.

DeBorgia

This study area is situated north of DeBorgia in Mineral County (Figure 3), and is bounded by Hemlock Mountain on the west, Twelvemile Creek on the east, the C-C Divide on the north and extends southwardly to an area near the St. Regis River. From the C-C Divide, the area slopes from elevations of approximately 6000 feet steeply to the south to about 4000 feet at the Osborne fault. South of this east-west line, topography is rolling and divided by numerous small streams, the most prominent being Packer, McManus, Timber, Twin, Savenac and Rock Creeks. Vegetation cover is dominated by forests in the *Abies grandis* series (Pfister et al. 1977).

The DeBorgia study area consists of two separate zones referred to as the Packer Creek zone on the west and the Middle Fork Rock Creek zone on the east. The area situated between these two zones, from Timber Creek to the West Fork of Twin Creek, is included as a secondary study zone (Figure 3). Study intensity

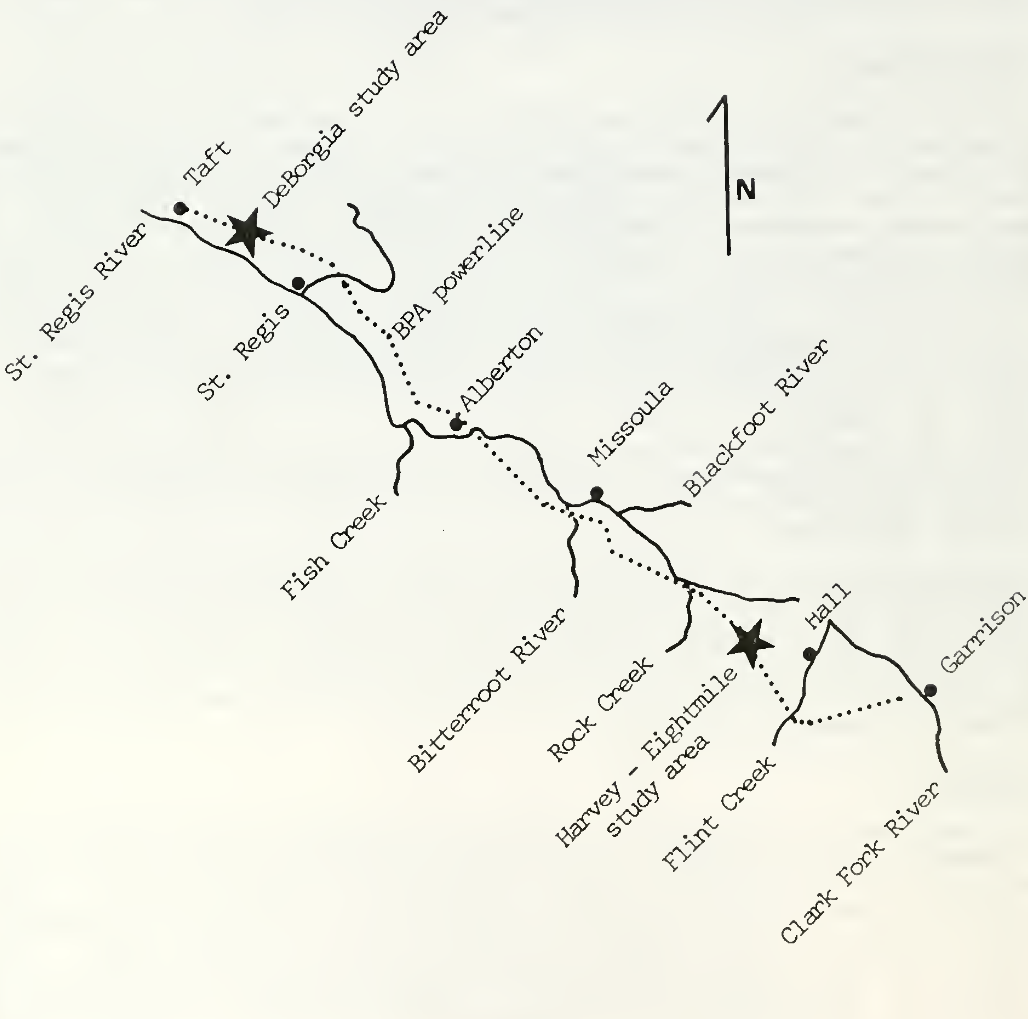


Figure 1. Locations of the Harvey-Eightmile and DeBorgia study areas along the 156 mile stretch of BPA powerline from Garrison-Taft, Montana.

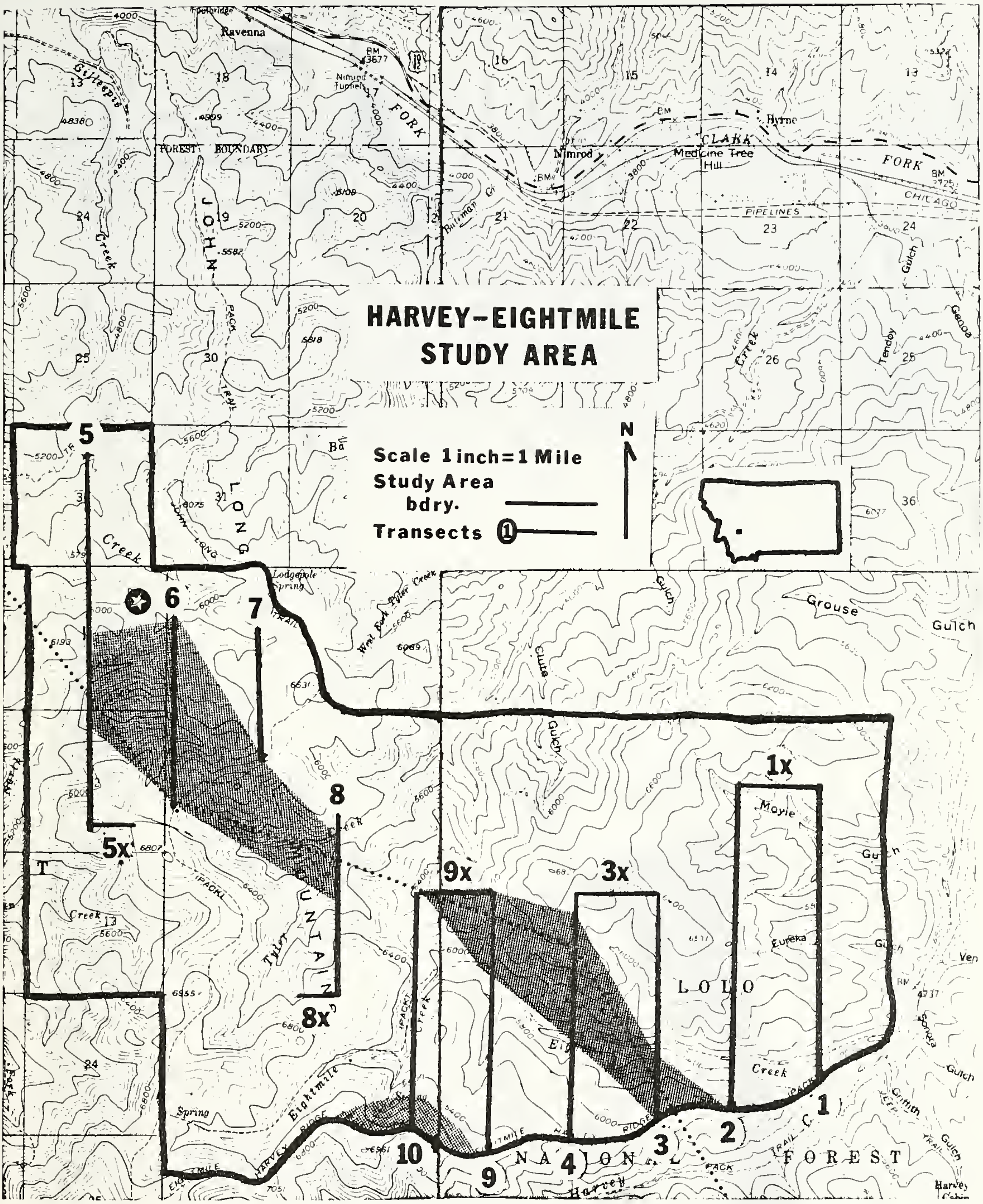


Figure 2. Location of the Harvey-Eightmile study area, pellet transects, and traffic counter (star) in relation to the BPA powerline (dotted line) near Hall, Montana. The shaded areas are powerline-influenced analysis units used to evaluate elk pellet-group distribution along the transects in relation to the powerline corridor and associated road network.

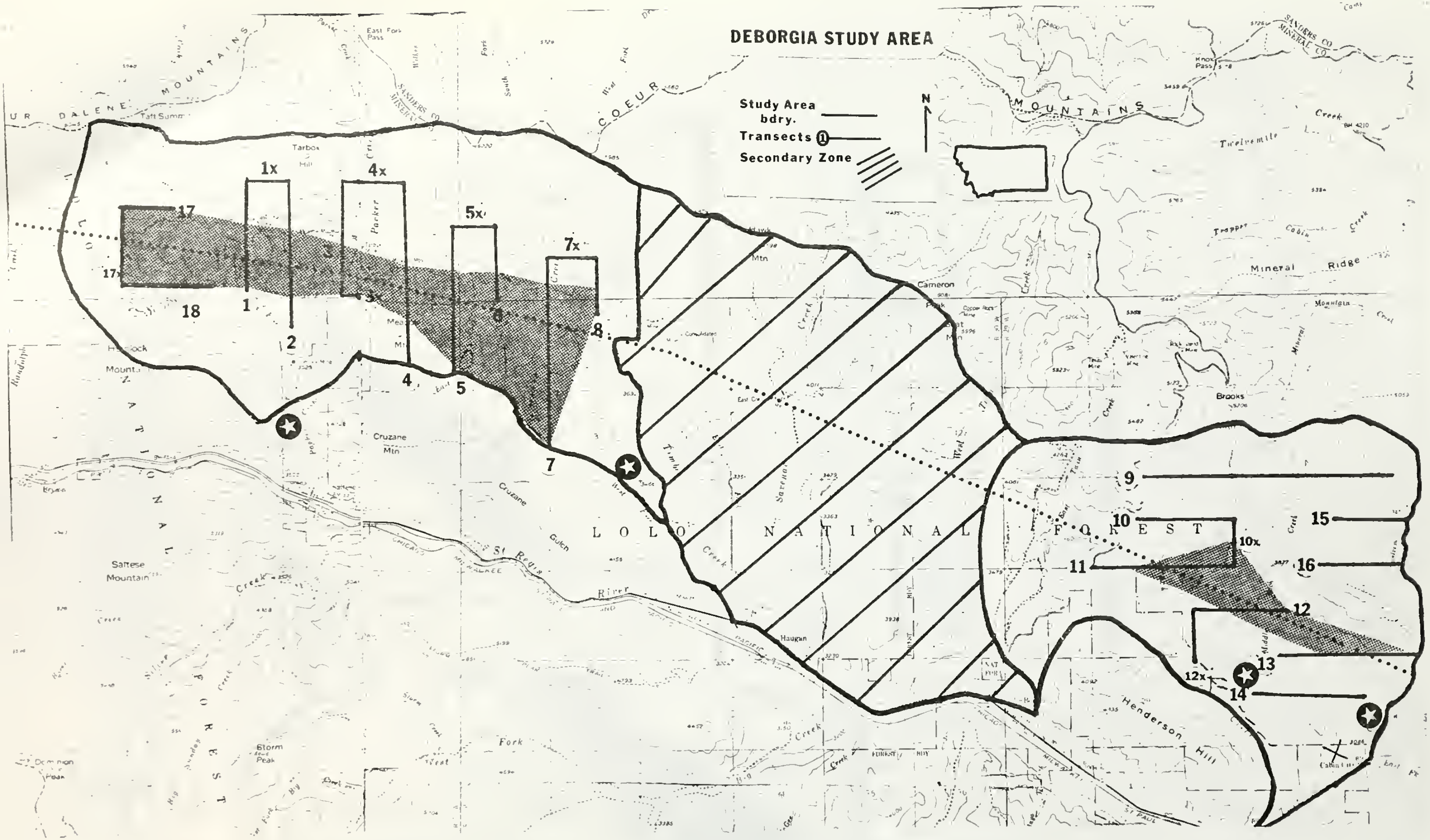


Figure 3. Location of the DeBorgia study area, pellet transects, and traffic counters (stars) in relation to the BPA powerline (dotted line) near DeBorgia, Montana. The shaded areas are powerline-influenced analysis units used to evaluate elk pellet-group distribution along the transects in relation to the powerline corridor and associated road network.

will be lower in this zone than in the primary study zones due to a larger proportion of private ownership. Within this zone, all USFS activities will be kept to a minimum and coordinated with this research effort.

The USFS and Champion International agreed to defer any additional logging in the Twelve-Rock timber sale (Middle Fork Rock Creek zone) until after this study is completed. The Hawk-Packer timber sale (Packer Creek zone) was an active sale in 1984 that affected at least study transects four through eight. Data analysis and recommendations will be handled differently for those areas where line construction and the Hawk-Packer sale overlap. To mitigate the influences of this activity, road building and logging in both the Hemlock Mountain (Packer Creek zone) and the Twin-Savenac Creek (secondary study zone) areas were deferred for the duration of this study. In addition, three new study transects (17, 17X, and 18) were established in 1984 on Hemlock Mountain, the study area's west end, to mitigate for disturbance associated with the Hawk-Packer sale. This sale was inactive in 1985.

PROGRESS

Progress in this report period on the tasks outlined in the study plan is detailed below.

1. Literature Review

An annotated bibliography of selected references reviewed to date is presented in Appendix A.

2. Mapping of Vegetation and Habitat Types

Existing habitat characteristics of the study areas have been mapped by the USFS according to their landtype classification system. Landtypes are habitat classification units with characteristic combinations of soils, vegetation, and landforms. Features described for each landtype include: elevation, aspect, slope, topography, present and potential vegetation, and moisture regime. The landtype classification system has proven to be useful for previous evaluations of seasonal habitat selection by ungulates (Thompson 1981, DeSimone et al. 1985, Joslin 1985). Current plans are to use the landtypes as habitat descriptors in conjunction with land-use variables such as road systems and cutting units to analyze the habitat selection of study area elk populations.

3. Develop Analytical Procedures and Standard Data Forms

Procedures and forms were devised and described previously (Hammond et al. 1985), and were not amended in this report period.

4. Elk Pellet Group Transects

Methods

Elk pellet groups were counted along permanent belt transects (6 ft. wide) to monitor elk distribution in relation to the powerline project (Figures 2, 3). Each transect was divided into segments at maximum intervals of 1/8 mile, and each segment was marked for the duration of the study with colored spray paint and strips of high-visibility plastic flagging. Habitat characteristics, including the parameters listed in Elliott (1983), were described for each segment. Each transect was walked three times in 1985: June 17-July 18, July 30-August 26, and September 23-October 10. Transect data was collected similarly in 1984 and in September-October 1983 (Hammond et al. 1985, Elliott 1983). Pellet-groups were cleared from the transects as they were counted. Hunting season (October-November) elk distribution was indicated by counting the number of old and very old pellet-groups in June and July along transects that were cleared of pellet-groups the previous September-early October (elk were assumed to spend December-April on winter ranges off the transects).

Pellet-group distribution were analyzed separately for the Middle Fork Rock Creek, Packer Creek, cutover, and uncut zones. The areas in which the impacts of powerline/road construction and increased access were expected to be greatest were delineated in each study zone. These areas encompassed the powerline corridor and associated road network. The areas located

between the corridor and the winding road network were included in these delineations, as well as adjacent areas on the same slope or topographic feature. These delineations formed powerline-influenced analysis units in each study zone (Figure 2 and 3). Construction and access disturbances to elk were expected to be greatly reduced outside these analysis units.

Relative elk use in powerline-influenced analysis units was indicated by comparing the proportions of total pellet groups counted with the proportions of total transect length within each analysis unit. Comparisons were made using the chi-square statistic. Differences in relative elk use before and after initiation of the powerline project were attributed to construction and access-related disturbance. Proportions were analyzed and evaluated rather than total pellet-group counts because large annual and seasonal variations in total pellet-group counts may be expected in response to uncontrollable variables (Marcum et. al. 1984). Data from unaffected elk populations in similar habitats were not available for use as controls. Therefore, proportional elk use was analyzed under the assumption that the proportion of elk use in powerline- influenced analysis units remained constant, regardless of variations in total pellet-group counts, unless elk distribution was affected by the powerline project.

Results and Discussion

Elk use of powerline-influenced analysis units from September 1983 - September 1985 was proportional to the relative availability of these analysis units in 27 of 36 (75%) analysis unit samplings (Chi-square, P 0.05). This supports the assumption that relative elk use of habitats within analysis units generally remained constant, despite large variations in total pellet counts (Tables 1-6).

Elk distribution was least affected by the powerline project in the Packer Creek study zone and the cut-over portion of the Harvey-Eightmile study area (Tables 1-6). Elk use of powerline-influenced analysis units in these two areas was proportional to the relative availability of these analysis units in 16 of 18 (89%) analysis unit samplings (Chi-square, P 0.05; tables 1, 3, 4, 6). Elk used these analysis units less than expected (Chi-square, P 0.05) in May-June 1984 (early construction) and in September 1983 (before construction). This indicates that the powerline project generally did not displace elk from powerline-influenced analysis units in the Packer Creek study zone and the cut-over portion of the Harvey-Eightmile study area. However, a low sample size of pellet groups counted in October-November 1984 precluded a valid statistical comparison of elk use in the Packer Creek study zone (Table 4).

Elk distribution was most affected by the powerline project in the Middle Fork Rock Creek study zone and the uncut portion of the Harvey-Eightmile study area (Tables 1-6). Elk use of powerline-influenced analysis units in these two areas was greater than expected (Chi-square, P 0.05) from their availability in 3 of 4 analysis unit samplings from September-November 1983 (before powerline construction). This indicates that these were preferred elk habitats during fall before the powerline project began. Elk use of these analysis units was proportional to (Chi-square, P 0.05) or less than (Chi-square, P 0.05) their availability in all six subsequent analysis

Table 1. Distribution of elk fecal pellets along transects in the Packer Creek study zone, Montana, during spring and summer of 1984 and 1985.

Transect Locations	Transect Length Yards(%Total)	Number of pellet groups (and % total) May - June 1984	May - June 1985	July - Aug 1984	July - Aug 1985
North of Powerline	9,160(39)	22(55)	2(15)	86(44)	21(24)
Powerline	12,470(52)	10(25)*	8(62)	101(52)	64(72)
South of Powerline	2,150(9)	8(20)	3(23)	8(4)	4(4)
TOTALS	23,780(100)	40(100)	13(100)	195(100)	89(100)

*Indicates that the proportion of total pellet groups was significantly less than the proportion of total transect length (Chi-square, P 0.05).

Table 2. Distribution of elk fecal pellets along transects in the Middle Fork Rock Creek study zone, Montana, during spring and summer of 1984 and 1985.

Transect Locations	Transect Length Yards(%Total)	Number of pellet groups (and % total) May - June 1984	May - June 1985	July - Aug 1984	July - Aug 1985
North of Powerline	10,580(54)	11(48)	40(78)	64(74)	67(79)
Powerline	2,750(14)	7(30)	3(6)	6(7)	2(2)*
South of Powerline	6,250(32)	5(22)	8(16)	16(19)	16(19)
TOTALS	19,580(100)	23(100)	51(100)	86(100)	85(100)

*Indicates that the proportion of total pellet groups was significantly less than the proportion of total transect length (Chi-square, P 0.05).

Table 3. Distribution of elk fecal pellets along transects in the Harvey-Eightmile study area, Montana, in spring and summer of 1984 and 1985.

Transect Locations	Transect Length Yards(% Total)	Number of pellet groups (and % total) May - June[a] 1984	May - June[a] 1985	July - Aug 1984	July - Aug 1985
Uncut Non-powerline	12,690(52)	2(6)	8(50)	34(40)	21(33)
Uncut Powerline	2,365(10)	14(38)**	2(13)	21(24)**	9(14)
Cut-over Non-powerline	5,945(24)	15(42)	5(31)	23(27)	22(35)
Cut-over Powerline	3,390(14)	5(14)	1(6)	8(9)	11(18)
TOTALS	24,390(100)	36(100)	16(100)	86(100)	63(100)

[a]Numbers were adjusted to provide a valid comparison because 2,975 yds. of the uncut control transects were not sampled in June 1984.

**Indicates that the proportion of total pellet groups was significantly greater than the proportion of total transect length (Chi-square, P 0.05).

Table 4. Distribution of elk fecal pellets along transects in the Packer Creek study zone, Montana, during the rut and hunting season, 1983-1985.

		Number of pellet groups (and % total)				
	Transect Length[a]	September			Oct - Nov	
Transect Locations	Yards(% Total)	1983	1984	1985	1983	1984
North of Powerline	3,410(36)	27(31)	20(25)	19(61)	12(35)	6(67)
Powerline	6,040(64)	60(69)	60(75)	12(39)	22(65)	3(33)
South of Powerline	0	-	-	-	-	-
TOTALS	9,450(100)	87(100)	80(100)	31(100)	34(100)	9(100)

[a]Transects that were not sampled during both years were not included here.

Table 5. Distribution of elk fecal pellets along transects in the Middle Fork Rock Creek study zone, Montana, during rut and hunting season, 1983-1985.

		Number of pellet groups (and % total)				
	Transect Length[a]	September			Oct - Nov	
Transect Locations	Yards(% Total)	1983	1984	1985	1983	1984
North of Powerline	2,175(19)	0(0)	4(6)	0(0)	34(21)	47(43)
Powerline	2,750(25)	17(46)**	11(17)	5(50)	55(35)**	13(12)*
South of Powerline	6,250(56)	20(54)	51(77)	5(50)	70(44)	49(45)
TOTALS	11,175(100)	37(100)	66(100)	10(100)	159(100)	109(100)

[a]Transects that were not sampled in both years are not included here.
*Indicates that the proportion of total pellet groups was significantly less than the proportion of total transect length (Chi-square, P 0.05).
**Indicates that the proportion of total pellet groups was significantly greater than the proportion of total transect length (Chi-square, P 0.05).

Table 6. Distribution of elk fecal pellets along transects in the Harvey-Eightmile study area, Montana, during the rut and hunting season, 1983-1985.

		Number of pellet groups (and % total)				
	Transect Length[a]	September			Oct - Nov	
Transect Locations	Yards(% Total)	1983	1984	1985	1983	1984
Uncut Non-powerline	7,080(37)	48(47)	71(50)	10(27)	75(33)	29(33)
Uncut Powerline	2,365(13)	17(17)	18(13)	1(3)	50(21)**	6(7)
Cut-over Non-powerline	5,945(32)	29(29)	35(24)	20(54)	70(30)	40(45)
Cut-over Powerline	3,390(18)	7(7)*	18(13)	6(16)	38(16)	13(15)
TOTALS	18,780(100)	101(100)	142(100)	37(100)	233(100)	88(100)

[a]Transects that were not sampled during both years are not included here.
*Indicates that the proportion of total pellet groups was significantly less than the proportion of total transect length (Chi-square, P 0.05.
**Indicates that the proportion of total pellet groups was significantly greater than the proportion of total transect length (Chi-square, P 0.05).

unit samplings (during powerline construction) for September 1984-1985 and October-November 1984 (Tables 2, 3, 5, 6). This indicates that elk were displaced from previously-preferred, powerline-influenced analysis units in the fall as a result of the powerline project in the Middle Fork Rock Creek study zone and the uncut portion of the Harvey-Eightmile study area.

Relative elk use also indicated a preference (Chi-square, P 0.05) for the powerline-influenced analysis unit in the uncut portion of the Harvey-Eightmile study area from May-August 1984 (Table 3). Elk used this unit less, only proportional to its availability (Chi-square, P 0.05), from May-August 1985. Powerline construction was underway in both 1984 and 1985; however, if we assume that differences in elk use of this unit from 1984 to 1985 may be attributed to the powerline project, then differences in the type and intensity of disturbance in 1985 may be indicated. Similarly, relative elk use of the powerline-influenced analysis unit in the Middle Fork Rock Creek study zone declined in July-August 1985 compared to the same period in 1984 (Table 2); this also may reflect a difference in disturbance levels.

Marcum and Scott (1985) found that large variations in annual and seasonal elk use in the Garnet Mountains of Montana were explained by the variation in cumulative precipitation. They cautioned that "erroneous conclusions concerning the influence of road-building and logging on elk distribution on summer range would be possible if one year of predisturbance data were obtained during a dry year, followed by disturbance data during a wet year" (Marcum and Scott 1985, p. 76). This does not appear to be a problem in interpretation of the results of this study. First, analysis units were selected independently of habitat characteristics; therefore, differential habitat selection caused by weather factors should not have altered elk distribution among analysis units. Results verified that elk use generally was distributed among analysis units in proportion to the relative availability of these units. Secondly, seasonal elk use of many analysis units did not vary proportionately from year to year despite broad variations in total pellet counts (Tables 1, 6). This indicates that observed annual variations in seasonal total pellet counts on the study area did not necessarily affect proportional elk use of analysis units within the study area.

The impacts of the powerline project on elk distribution were greatest during hunting season, when elk were displaced in 2 of 4 study zones. This was expected because of the increased access provided to hunters by the new roads built for powerline construction and maintenance. The fact that elk were not displaced during hunting season in the other two study zones indicates that the powerline project caused different elk responses along the 156-mile length of the corridor. Further, differential elk responses were not specific to the DeBorgia or Harvey-Eightmile study areas; elk responses were different between study zones in the moist, densely-forested DeBorgia area and between uncut and cut-over units in the drier, more open Harvey-Eightmile area.

Habitat effectiveness or security decreases as cover decreases and road density increases (Lonner and Cada 1982, Lyon et al. 1985). Road closures to public vehicular traffic often do not compensate completely for losses in habitat effectiveness because of the improved trail system that closed

roads provide for hunters on foot and horseback (Lonner and Cada 1982). The effectiveness of hunting season road closures along the powerline was further reduced because construction activity on these roads continued through the hunting season of 1984. Elk may have reacted more strongly to construction traffic in hunting season if elk associated that activity with hunting. Different types and/or intensities of construction activity in different study zones may have resulted in the different elk responses noted during hunting season. Monitoring of hunting season elk distribution in 1985 (based on pellet counts in June-July 1986) and 1986 will provide for assessment of: (1) the persistence of elk displacement and (2) the effectiveness of public road closures in the absence of construction activity.

Relative security levels prior to the powerline project, in addition to relative levels of powerline construction activity, may have caused differential elk responses to the powerline project during hunting season. Elk in the Harvey-Eightmile study area were less affected by the powerline project in the previously cut-over analysis unit than in the uncut unit. Elk avoided the cut-over unit in September 1983 and preferred the uncut unit in October-November 1983, indicating that security levels were already reduced by prior logging and roading in the cut-over unit before powerline construction began. Additional roading and activity associated with the powerline may have had less impact on elk in the cut-over unit because the value of the unit as elk security was already relatively low. Conversely, powerline project activities in previously-undisturbed habitats preferred by elk reduced security levels and caused a shift in elk distribution.

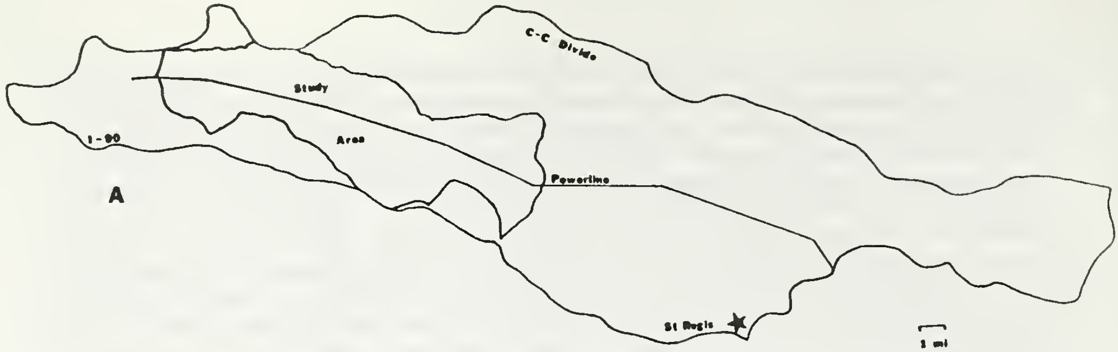
5. Summarize Elk Hunting Regulations and Harvest Data

Harvest Trends

The DeBorgia and Harvey-Eightmile study areas are located within elk hunting districts (HD) 200 and 210, respectively (Fig. 4). Elk harvest trends since 1972 in these hunting districts (from annual MDFWP statewide harvest surveys) were examined to detect powerline-related impacts on elk harvests in 1984 (Figures 5 and 6). Hunting regulations pertaining to the harvest of antlered bulls remained relatively constant from 1972-1984, but opportunities to harvest antlerless elk were restricted beginning in 1976 and 1980 in HD's 210 and 200, respectively (Table 7).

Elk harvests varied greatly from year to year in both hunting districts during the 12 years immediately preceding powerline construction activities (Figures 5 and 6). This normal variation in annual elk harvests must be predictable to determine if unexpected harvest levels occurred in 1984 (the first year of powerline construction).

An attempt was made to explain the annual variation in spike harvests from 1972-1983 using multiple linear regression. A statistically valid regression equation could be used as a model to predict the expected 1984 spike harvest in the absence of powerline-related influences. Spike harvest was selected as the dependent variable because: (1) annual antlered male harvests have been affected less by changes in hunting regulations since 1972 than antlerless harvest, and (2) annual spike



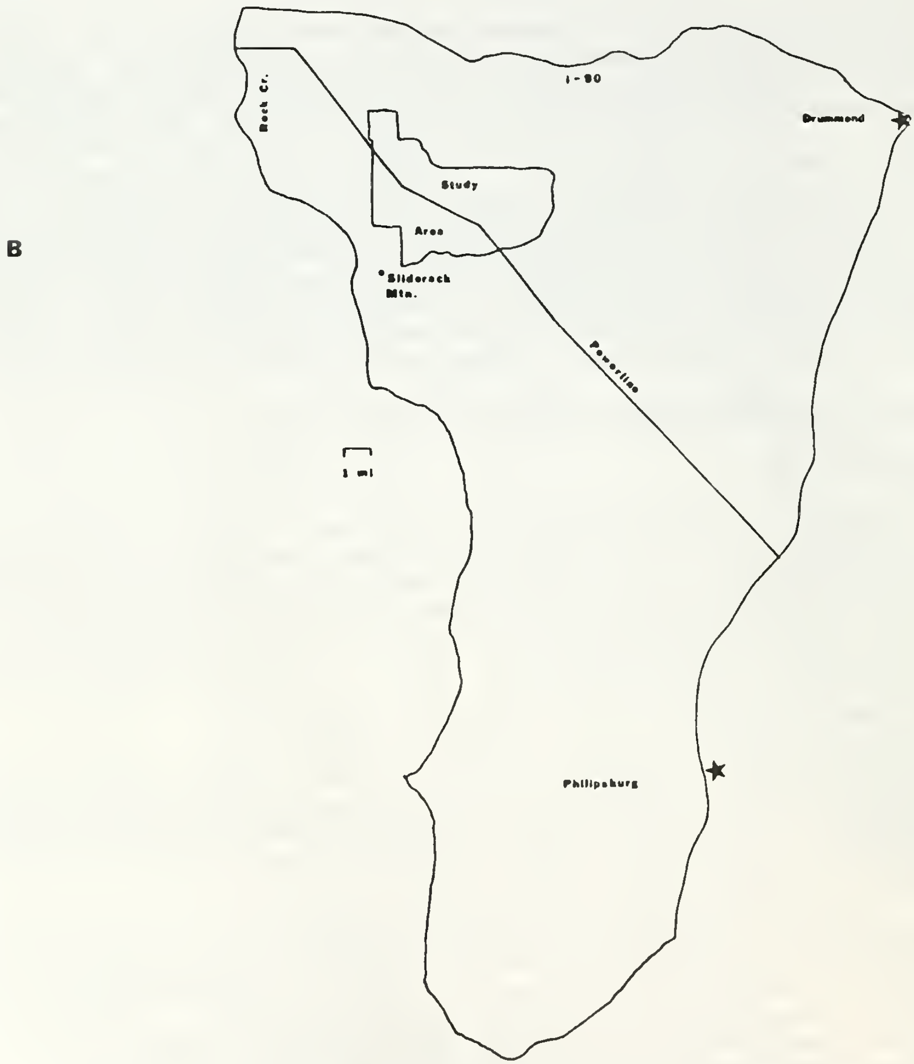


Figure 4. Location of the DeBorgia study area and BPA powerline in relation to Montana elk hunting district (HD) 200 (A), and location of the Harvey-Eightmile study area and BPA powerline in relation to HD 210 (B).

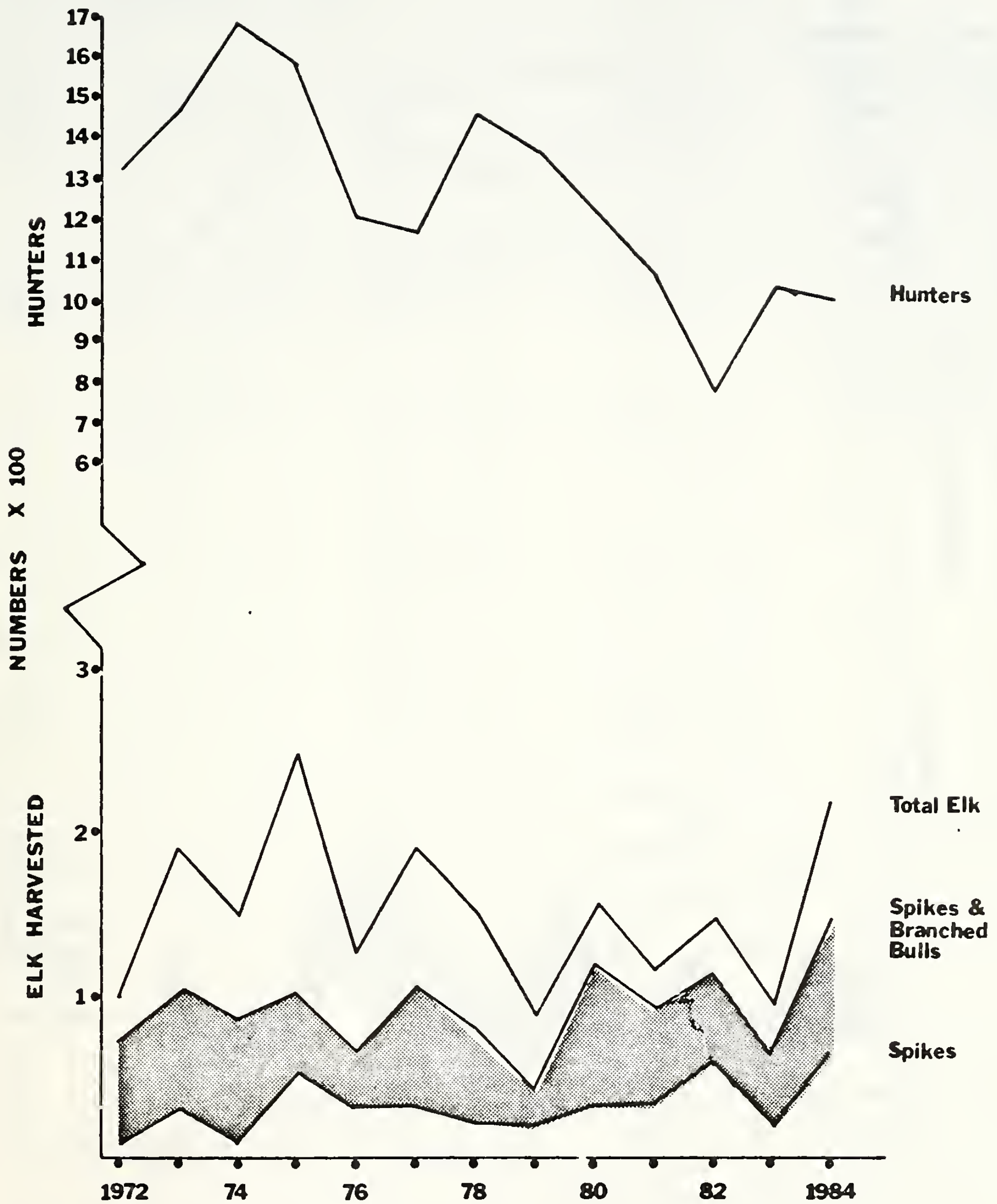


Figure 5. Trends in hunting pressure and elk harvests from 1972-1984 in Montana hunting district 200, near DeBorgia.

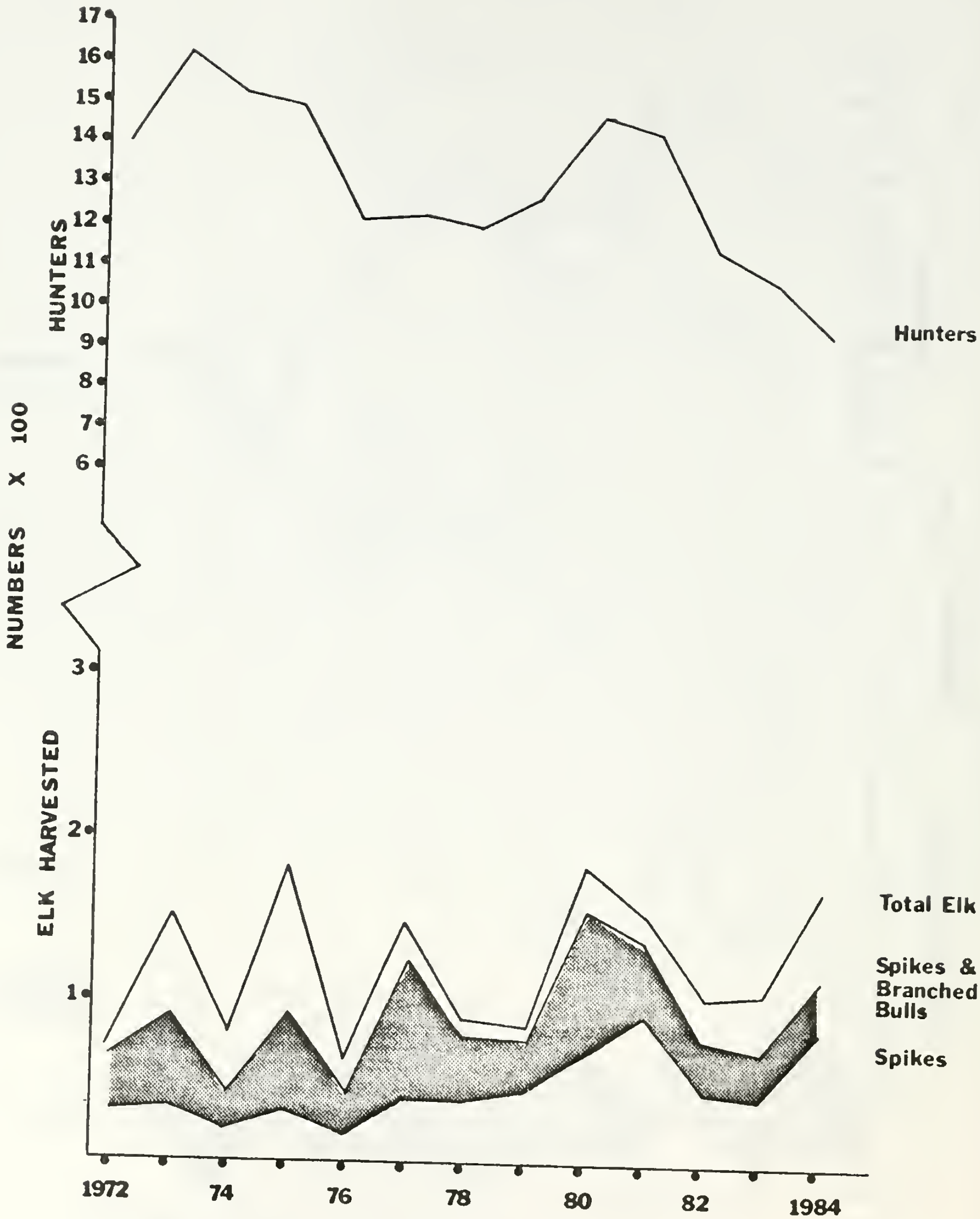


Figure 6. Trends in hunting pressure and elk harvests from 1972-1984 in Montana hunting district 210, near Hall.

Table 7. Summary of regulations for Montana elk hunting districts (HD) 200 and 210 from 1972-1985.

Year	Season	Bag Limits		Number of Either Sex or Antlerless Permits	
		HD 200	HD 210	HD 200	HD 210
1972	Oct. 21 - 31	Either sex	Either Sex	0	0
	Nov. 1 - 18 (25*)	Antlered bull	Antlered bull	0	0
1973	Oct. 21 - 31	Either sex	Either Sex	0	0
	Nov. 1 - 18 (25*)	Antlered bull	Antlered bull	0	0
1974	Oct. 20 - 31	Either sex	Either Sex	0	0
	Nov. 1 - 17 (24*)	Antlered bull	Antlered bull	0	0
1975	Oct. 19 - Nov. 2	Either sex	Either Sex	0	0
	Nov. 3 - 23	Antlered bull	Antlered bull	0	0
1976	Oct. 24 - 31	Either sex	Antlered bull	0	50
	Nov. 1 - 28	Antlered bull	Antlered bull	0	same
1977	Oct. 23 - 30	Either sex	Antlered bull	0	25
	Oct. 31 - Nov. 27	Antlered bull	Antlered bull	0	same
1978	Oct. 22 - 29	Either sex	Antlered bull	0	25
	Oct. 30 - Nov. 26	Antlered bull	Antlered bull	0	same
1979	Oct. 21 - 23	Either sex	Antlered bull	0	50
	Oct. 24 - Nov. 25	Antlered bull	Antlered bull	0	same
1980	Oct. 19 - Nov. 30	Antlered bull	Antlered bull	100	50
1981	Oct. 25 - Nov. 29	Antlered bull	Antlered bull	100	50
1982	Oct. 24 - Nov. 28	Antlered bull	Antlered bull	100	50
1983	Oct. 25 - Nov. 27	Antlered bull	Antlered bull	100	50
1984	Oct. 21 - Nov. 25	Antlered bull	Antlered bull	125	115
1985	Oct. 27 - Dec. 1	Antlered bull	Antlered bull	125	250

*Season closing date for HD 210 only.

harvests were less variable and probably more easily explained than branch-antlered bull harvests.

Annual spike harvests were assumed to vary with hunting effort and elk availability. Historical records of hunting effort were available for both hunting districts, but five years of information on elk availability was available only for HD 210. Therefore, a regression model of spike harvest was calculated for HD 210, but not for HD 200.

Elk population trend counts and calf/cow ratios (MDFWP annual progress reports, Region 2) during spring were entered in the regression as indicators of spike numbers the following hunting season. Hunter numbers (MDFWP statewide harvest surveys) were entered as indicators of hunting effort. October and November snowfall levels at Drummond airport (U.S. Dept. of Commerce 1978-1983.) also were entered because of their suspected influences on both elk availability and hunting efforts (Table 8).

Table 8. Spike elk harvest and variables that might affect spike harvest in Montana elk hunting district 210.

Year[a]	Spike Harvest[b]	Number of Hunters[b]	Elk Trend Count[c]	Calves per 100 cows[c]	October Snowfall (in)[d]	November Snowfall (in)[d]
1978	36	1,197	173	49	0.0	11.7
1979	43	1,267	231	42	0.0	1.5
1980	68	1,475	375	60	1.1	1.9
1982	42	1,149	349	54	1.7	4.0
1983	39	1,075	329	44	0.0	4.6
1984	83	952	415	48	3.5	3.0

[a]Only those years from 1972-1984 when both trend counts and calves/100 cows were available are listed.

[b]From Montana Department of Fish, Wildlife and Parks (MDFWP) annual statewide harvest surveys.

[c]From MDFWP annual progress reports (Region 2, Missoula).

[d]From U.S. Department of Commerce, Climatological Data for Montana (Drummond Airport).

The backward elimination procedure (Draper and Smith 1966) was used to find the best regression model, incorporating only the most influential independent variables. Hunter numbers (partial $r = 0.9913$, $P = 0.006$) and elk population trend counts (partial $r = 0.9719$, $P = 0.02$) were the two best indicators of spike harvests, and accounted for about 99% of the variation in annual spike harvests in HD 210 ($R^2=0.989$). The best regression equation was statistically significant at the 1% level ($F = 92.5$, $P = 0.009$). This equation ($Y = 0.067$ (hunter numbers) $+ 0.066$ (trend count) $- 56.42$) predicted a 1984 spike harvest of 35 (S.E.=2.6), using the spring, 1984 trend count and 1984 hunter numbers. The actual 1984 spike harvest from the statewide harvest survey was 83.

This analysis indicates that the spike harvest in HD 210 during the first year of the powerline project (1984) was more than twice that expected from recent harvest trends. This suggests that something occurred between the hunting seasons of 1983 and 1984 to disrupt the harvest-reproduction-weather relationship of the previous 6-year period. The construction of about 44.7 miles of new roads and 27.5 miles of cleared right-of-way for the powerline project across HD 210 was the most obvious occurrence that could have disrupted past harvest trends. About 38% (13 of 34 successful hunters sampled) of the reported 1984 elk harvest by antlerless permit-holders in HD 210 occurred in drainages that cross the Harvey-Eightmile study area, and an additional 12% (4 of 34) of the antlerless harvest occurred in drainages crossed by the powerline elsewhere in HD 210 (MDFWP 1984 statewide harvest survey). This confirms that a substantial proportion of the elk harvest in HD 210 could be influenced by the construction of the powerline and road system.

Increased hunter access via new roads with vehicular travel restrictions may be expected to increase the number of animals observed, and possibly to increase the kill (Basile and Lonner 1979, Lyon et al. 1985, pp 8-9). This could explain the higher-than-expected spike harvest in HD 210 following right-of-way clearing and road construction.

Results of this study also indicated that elk were displaced from preferred security areas in HD 210 during hunting season as a result of the powerline project. Displaced elk may have moved through less secure habitats and may have been more vulnerable to hunting; this also could contribute to an unusually high spike harvest.

Harvest Rates

Mortality of radioed elk has been monitored in the study areas for the past two hunting seasons (1984 and 1985). Three antlered bull elk were monitored through hunting season 1984 and five bull elk were monitored through hunting season 1985, for a total of 8 bull-hunting seasons monitored thus far in the DeBorgia area. One of these bulls was harvested in 1985. One antlered bull was monitored through two hunting seasons in Harvey-Eightmile, and it was harvested in 1985 along the East Fork of the Bitterroot River (about 44 miles south of the Harvey-Eightmile study area). Although sample sizes currently are small, continued monitoring of more radioed bulls in 1986 and 1987 should provide a reasonable estimate of bull harvest rates (at least in the DeBorgia area). This will help in evaluating the consequences of an increased bull harvest along the powerline.

Similarly, 2 cow elk were monitored through hunting season 1984 and 12 cow elk were monitored through hunting season 1985, for a total of 14 cow-hunting seasons monitored thus far in the DeBorgia area. None of these cow elk were known to be harvested. Seven cow elk were monitored through hunting season 1984 and two cow elk were monitored through hunting season 1985, for a total of 9 cow-hunting seasons monitored thus far in the Harvey-Eightmile area. One of these cows was known to be harvested in 1984 and another cow elk mortality could have occurred in hunting season 1984 (although the carcass was left in the field). Continued monitoring of more radioed cow elk in 1986 and 1987 should provide an estimate of cow harvest rates in both study areas.

Check Stations

Hunter check stations were operated near Hall in HD 210 (T9N, R13W, 7) and at the intersection of the Rock Creek road and Camel's Hump Highway in HD 200 (T19N, R9E, 33) on opening day of the 1985 general big game season (October 27). Eleven elk were harvested by 100 hunters checked at the Hall check station; most of those were taken on private land by antlerless permit-holders (Table 9). No elk were harvested by 41 hunters checked at Rock Creek, or by 64 hunters checked on the Camel's Hump Highway on opening day.

The Rock Creek - Camel's Hump check station was also operated on Saturday and/or Sunday of each weekend of the hunting season in conjunction with trips necessary to read traffic counters (Table 9). Only one calf elk was harvested by 209 hunters checked on weekends after opening day. This is consistent with check station data from HD 200 in 1984; only 3 elk were harvested by 329 hunters checked at 3 access points (Hammond et al. 1985). Access and harvest in HD 200 is not restricted to any particular road system, making check stations ineffective as a means of collecting harvest data. Local residents and hunters reported that several elk were harvested in the Rock Creek drainage, but they were not checked at the check station.

About 98% (41 of 42) of the hunter vehicles checked at the Hall station were licensed in Montana; about 52% were licensed locally (Granite County) and 38% were from Missoula County (Table 10). About 82% (131 of 160) of the hunter vehicles checked near DeBorgia were licensed in Montana; about 44% were licensed locally (Mineral and Sanders Counties) and 14% were from Missoula County.

6. Assist with DNRC Hunter Opportunity Survey

Phase II of the Hunter Opportunity Survey was postponed until 1986 by DNRC because of continuing construction activities in the study areas.

7. Install and Monitor Car Counters

Methods

Traffic counters were monitored at five locations in the two study areas (Figures 2 and 3) as in 1983 (Allen 1984) and 1984 (Hammond et al. 1985). The counters were operational one week prior to the general hunting season and were removed one week after the hunting season closed to provide estimates of non-hunter and hunter traffic. Readings were taken Saturday morning and Sunday night each weekend at the four locations on the DeBorgia study area. A Fisher-Porter automatic counter was borrowed from the Deerlodge National Forest for use at the Beavertail location, eliminating the need for reading that counter.

Table 9. Weather conditions and harvest by hunters checked on Saturdays and/or Sundays of the 1985 big game hunting season in Montana elk hunting districts (HD) 200 and 210.

					Elk Harvest				Deer Harvest			
									Mule Deer		Whitetail Deer	
Check Station	Date	Number of Hunters	Temp. °F	Snow[a] Depth	Calves	Adult Cows	Yearling Bulls	Older Bulls	Adult Does	Adult Bucks	Adult Does	Adult Bucks
Hall (HD 210)	10/27[b]	100	55	0	3	4	1	3	2	1	0	0
Rock Cr. (HD 200)	10/27[b]	41	40	0	0	0	0	0	0	0	0	0
	11/2[c]	4	40	0	0	0	0	0	0	0	0	0
	11/3	12	55	0	0	0	0	0	0	0	0	1
	11/9	18	20	0	0	0	0	0	0	0	0	0
	11/16	8	30	3	0	0	0	0	0	0	0	0
	11/23	18	-10	5	0	0	0	0	0	0	0	0
	12/1[d]	22	0	12	0	0	0	0	0	0	0	0
	TOTAL	123			0	0	0	0	0	0	0	1
Camel's Hump Highway (HD 200)	10/27[b]	64	40	0	0	0	0	0	1	0	0	0
	11/2[c]	20	40	0	0	0	0	0	0	0	0	0
	11/9	50	20	0	1	0	0	0	0	0	0	0
	11/16	11	30	3	0	0	0	0	0	0	0	0
	11/23	31	-10	5	0	0	0	0	0	0	0	0
	12/1[d]	15	0	12	0	0	0	0	0	0	0	1
	TOTAL	191			1	0	0	0	1	0	0	1

[a] measured in inches at check station
[b] opening day of general hunting season
[c] check station only operated from 0900-1230 hr. to accommodate simultaneous DNRC study
[d] closing day of general hunting season

Table 10. Origin of hunters checked on Saturdays and/or Sundays of the 1985 big game hunting season in Montana elk hunting districts (HD) 200 and 210.

		Licenses of Hunter Vehicles									
Check Station	Date	WA	MN	ID	WI	OR	NJ	Local	Missoula County	Other Montana	Total
Hall (HD 210)	10/27	0	0	0	0	1	0	22	16	3	42
Rock Cr. (HD 200)	10/27	2	2	0	0	0	0	7	1	6	18
	11/2	1	0	1	0	0	0	0	0	1	3
	11/3	0	0	1	0	0	0	3	2	1	7
	11/9	1	0	1	1	0	1	3	1	1	9
	11/16	1	0	0	0	0	0	2	0	1	4
	11/23	0	1	0	0	0	0	5	2	4	12
	12/1	0	0	1	0	0	0	7	2	2	12
	TOTAL	5	3	4	1	0	1	27	8	16	65
Camel's Hump Hwy. (HD 200)	10/27	3	1	2	2	0	0	14	3	6	31
	11/2	0	1	1	0	0	0	1	4	3	10
	11/9	2	0	1	1	0	0	11	2	6	23
	11/16	0	0	0	0	0	0	5	0	1	6
	11/23	0	0	1	0	0	0	8	3	5	17
	12/1	0	0	0	0	0	0	5	2	1	8
	TOTAL	5	2	5	3	0	0	44	14	22	95

Results and Discussion

Hunting season traffic counts increased at 4 of 5 locations from 1983 to 1984 (Table 11), at least partially reflecting the addition of powerline construction traffic in 1984. Conversely, hunting season traffic counts decreased at 4 of 5 locations from 1984 to 1985 (Table 11), partially reflecting a decrease in construction activity. Hunting season traffic counts in 1985 (post construction) fell below 1983 (pre-construction) levels at 3 of 5 locations. This may be indicative of a hunter response to the powerline project. It may also reflect independent variations in hunter effort from year to year (Table 12).

Table 11. Comparison of hunting season traffic counts at 5 locations along the BPA 500kv transmission line from Garrison-Taft, Western Montana, 1983-1985.

	Traffic Count		
Location	1983[a]	1984[b]	1985[c]
Beavertail	1418	1469	1075
Cabin City	989	1217	1120
Middle Rock	724	1087	821
Haugen	902	622	702
Saltese	1310	2056	836

[a] Oct 25-Nov 27 (Allen 1984).
[b] Oct 21-Nov 25 (Hammond et al. 1985).
[c] Oct 27-Dec 1

Table 12. Elk hunter-days of effort in western Montana, 1980-1984.

	Hunter-Days[a]		
Year	Hunting District 200	Hunting District 210	MDFWP Region 2
1980	5,441	5,502	157,859
1981	6,687	7,926	186,420
1982	4,394	5,889	169,148
1983	5,836	6,605	191,722
1984	5,950	4,546	172,078

[a] from MDFWP statewide harvest survey.

Hunting season traffic counts reflect non-hunting traffic volumes as well as hunting traffic. An attempt was made to account for nonhunting traffic in the hunting season traffic counts by counting traffic during the weeks

immediately preceding and immediately following hunting season. However, non-hunting traffic was not consistent before and during hunting season (Table 13); therefore, a valid correction factor could not be obtained by this method. Further, snow accumulations at the end of hunting season abruptly restricted car and truck travel, but greatly increased snowmobile travel; therefore, traffic after hunting season also was not representative of non-hunting traffic during hunting season. Counts of nonhunting vehicles passing check stations in hunting season were used by Allen (1984) to correct hunting season traffic counts. This method may provide more satisfactory results than pre- and post-season traffic counts.

8. Capture and Collar Elk

Methods

Elk were captured at DeBorgia on summer ranges by using modified clover traps (Clover 1954) baited with block salt. The age of each captured elk was estimated by examining the condition of the upper canine teeth (Greer and Yeager 1967). Elk were marked with a numbered metal tag in each ear, and the sex of each elk was recorded. All elk were fitted with radio transmitters encapsulated in individually recognizable neck collars constructed of molded PVC pipe.

Results

Elk trapping efforts were confined to the DeBorgia area in 1985 to increase the sample size of radioed elk in that heavily forested habitat. Traps were checked on 44 days between May 23 and August 9, for a total of 146 trap-nights of effort (Table 14). Trap sites were concentrated along Rock Creek, Randolph Creek and Meadow Mountain (Figure 7). Twelve elk were successfully radioed as a result, bringing the total radioed sample to 18 in the DeBorgia area (Table 15). Six of eight elk radioed at Harvey-Eightmile in 1984 survived into 1985 (Table 16).

9. Monitor Radio Collars and Map Elk Security Areas

Methods

Radio-collared elk were relocated from a Piper Super Cub aircraft equipped with two Yagi antennas. Supplemental relocations were made from the ground using a hand-held antenna; this was attempted infrequently because of the difficulty in obtaining precise relocations. Relocation frequency varied from daily to monthly depending upon season and study area. Relocations were recorded by UTM (Universal Transverse Mercator) coordinates; date, time of day, elevation and environmental conditions were also noted. Data were transferred to standard IBM data sheets and entered in computer files at Montana State University, Bozeman, for future analysis.

Monitoring Effort

Elk distribution in 1985 was represented by 296 relocations of 18 radioed elk at DeBorgia, and 63 relocations of 6 radioed elk at Harvey-Eightmile. Monitoring effort was concentrated in the summer and fall, but limited information on winter and spring distribution also was collected (Table 17).

Table 13. Weekly traffic counts at 5 locations along the BPA 500kv transmission line from Garrison-Taft, western Montana, 1985.

	Beavertail		Middle Rock		Cabin City		Haugen		Saltese	
	Weekend	Weekdays	Weekend	Weekdays	Weekend	Weekdays	Weekend	Weekdays	Weekend	Weekdays
Oct 19 - 25[a]	215	256	10	38		45	22	34	82	84
Oct 26-Nov 1	217(82)[b]	211	71(46)[b]	152	131(63)[b]	297	93(45)[b]	172	118(64)[b]	218
Nov 2-8	128	123	43	154	84	191	54	83	91	121
Nov 9-15	63	136	47	98	80	121	60	94	51	93
Nov 16-22	78	126	29	121	41	104	49	70	46	74
Nov 23-29	51		75		72		42		46	
Nov 30-Dec 1	77		56		67		33		32	

[a] week immediately preceding hunting season.
[b] count for opening day of hunting season (Oct 27).

Table 14. Trapping effort and results on elk summer range near DeBorgia, Montana in 1985.

Trapping Period	Weather	No. of Trap-nights	No. of Elk Trapped[a]	No. of Trap-nights/ Elk Trapped	No. of Elk Trapped That Escaped[b]	No. of Mortalities
23 May - 2 Jun	cool, rain	28	7	4.0	5	1[c]
17 Jun - 2 Jul	hot, dry	50	7	7.1	2	0
18 Jul - 1 Aug	hot, dry	60	6	10.0	0	0
8 Aug - 9 Aug	cool, rain	8	0	-	-	-
TOTALS		146	20	7.3	7	1

[a] including trap malfunctions, escapes, and mortalities

[b] Four elk broke out of the traps by breaking the netting or lashing, two elk escaped when trap doors stuck open, and one escaped from under the trap as it was being folded.

[c] This mortality occurred on 2 June, and apparently was the result of complications associated with pregnancy.

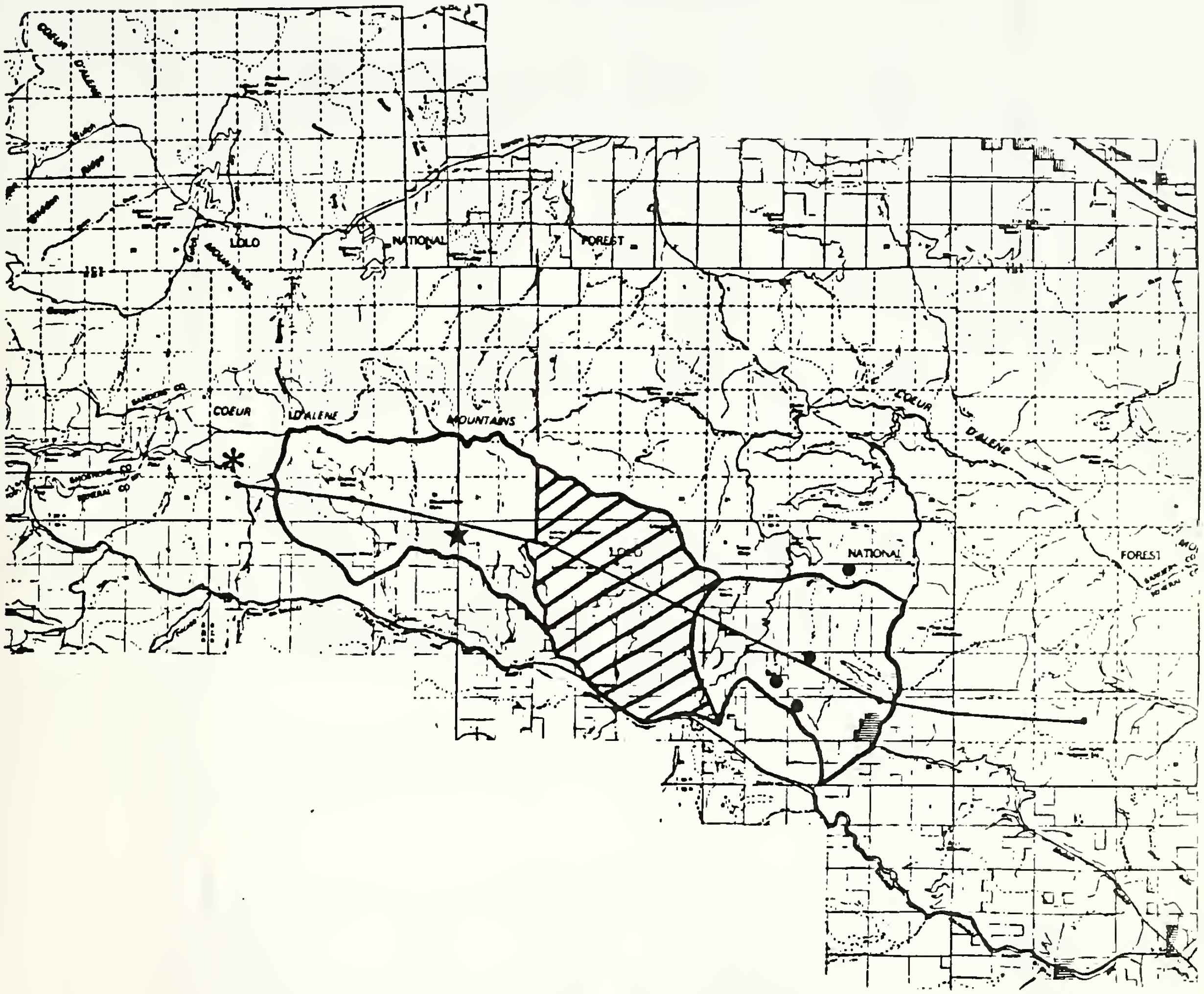


Figure 7. Trap site locations where elk were captured during the summers of 1984 and 1985 near DeBorgia, Montana (asterisk, star, and dots represent the Randolph Creek, Meadow Mountain, and Rock Creek trap sites). The powerline and study area boundaries are also shown.

Table 15. Identification data for 18 elk captured near DeBorgia, Montana during the summers of 1984 and 1985.

Capture Location	Date	Sex	Age (yrs.)[a]	Ear Tag Nos.	Collar Code[b]	Radio Frequency	Status
Rock Cr.	11 May 84	M	1	11752,11751	Blu	151.387	Dead[c]
	4 Jun 84	M	1	14217,14216	R/Blk bars	151.344	Unknown[d]
	29 Jun 84	M	4-6	14227,14228	Y/G bars	151.539	Working
	18 Jun 85	F	2	20404,20405	W/Blk blocks	151.712	Working
	28 Jun 85	F	3	20410,20409	W/R checker	150.978	Working
	18 Jul 85	M	1	20419,20425	W/Blk slash	151.164	Working
	29 Jul 85	F	1	20403,20406	W/R x	151.584	Working
	31 Jul 85	M	1	20417	W/Blk and R diamond	151.214	Working
Meadow Mtn.	14 Jul 84	F	1	none	G	151.211	Working
	7 Sep 84	M	1/2	none	Y/Blk bars	151.788	Working
	20 Jul 85	F	2+	20414	Y	150.942	Working
	21 Jul 85	F	1	20411	W/Blk dots	151.110	Working
	30 Jul 85	F	1	20418	W/Blk triangle	151.686	Working
Randolph Cr.	28 Jul 84	F	4-6	14227	R	151.286	Working
	25 May 85	F	2+	None	W/Blk stripes	151.768	Working
	20 Jun 85	F	7-9	20407	W/Blk bars	150.812	Working
	27 Jun 85	F	2	20401,20408	W/Blu checker	151.758	Working
	30 Jun 85	F	1	20421	W/Blk plus	151.317	Working

[a] estimated at time of capture
[b] Base color/Symbol color and symbol type: W = white, Y = yellow, R = Red, G = green, Blu = blue, Blk = black
[c] Harvested by a hunter on Clark Mountain on 27 October 85
[d] last relocated on 12 June 85

Table 16. Identification data for 8 elk captured near Hall, Montana during April 1984.

Capture Location	Date	Sex	Age (yrs.)[a]	Ear Tag Nos.	Collar Code[b]	Radio Frequency	Status
Cow Cr.	18 April 84	F	5-7	A11748,A11747	W/R bars	150.863	Unknown[c]
			8-10	A11745,A11746	W/Y bars	150.946	Harvested (1984)
			4-6	A11739,A11740	W/R bars	151.016	Working
W. Fk. Willow Cr.	18 April 84	F	3-4	A11743,A11744	Blu/Y bars	150.976	Unknown[d]
	19 April 84	F	4-6	A11741,A11742	W	151.215	Dead (1984)
			6-10	A11737,A11738	Blu/R bars	150.878	Working
Brewster Cr.	18 April 84	F	2	A11749,A11750	W/G bars	151.360	Dead (1985)
Spring Cr.	19 April 84	M	2	A11734,A11735	Y/R bars	151.765	Harvested (1985)

[a] estimated at time of capture
[b] base color/symbol color and symbol type: W = white, Y = yellow, R = Red, G = green, Blu = blue, Blk = black
[c] last relocated 25 September 85
[d] last relocated 16 August 85

Table 17. Monthly relocation effort spent on radioed elk in the Harvey-Eightmile (H-E) and DeBorgia (D) study areas in western Montana, 1985.

Month	Study Area	No. of Relocation Flights	No. of Ground Surveys	Total Relocations	No. of Elk Relocated[a]	Known No. of Radioed Elk[b]
Jan.	H-E	1	0	5	5	6
Apr.	H-E	2	0	9	6	6
	D	2	0	12	6	6
May	H-E	1	1	6	4	6
	D	1	0	6	6	6
Jun.	H-E	3	0	15	5	6
	D	1	0	7	7	7
Jul.	H-E	1	0	5	5	5
	D	2	0	24	14	15
Aug.	H-E	1	0	5	5	6
	D	4	0	66	17	17
Sep.	H-E	2	0	7	4	5
	D	4	0	54	17	17
Oct.	H-E	2	1	9	3	4
	D	7	1	87	17	17
Nov.	D	2	2	31	15	16
Dec.	H-E	1	0	2	2	2
	D	1	0	9	9	16
TOTALS	H-E	14	2	63	6[c]	
	D	24	3	296	18[c]	

[a] Number of radioed elk relocated at least once in the month.
[b] Number of elk known to be alive with functional radio collars.
[c] Total number of different elk that were radioed and relocated at least once in 1985.

Seasonal Ranges (Harvey-Eightmile)

Relocation maps for the winter (January), spring (April-9 May), calving (23 May-19 June), summer (July-August), rutting (September), and fall (October-10 December) seasons are presented in Appendix B. Radioed elk generally displayed similar movement patterns in 1985 as reported for the same elk in 1984 (Hammond et al. 1985). The radioed bull (captured at 2 yrs. of age in 1984) could not be found after 25 April; it was harvested by a hunter along the upper East Fork of the Bitterroot River (about 40 miles south of the study area) in November. This bull was relocated once near Sand Basin (about 15 miles north of the harvest location) on 17 July 1984, which was the only summer relocation recorded for this bull. Seasonal movements of the remaining 5 radioed cow elk are described below.

The winter range was located along the Babcock Creek and Spring Creek tributaries of the Rock Creek drainage. Elk moved southeast about 12 miles to the Harvey Ridge and Lower Willow Creek areas in spring. Elk moved about 2-3 miles south along the powerline to the McLean Creek and Jenkins Ridge area at the peak of calving season, and then moved about 5 miles west to higher-elevation ranges along Black Pine Ridge as summer progressed. Most summer relocations were at the heads of the Goose Gulch and North Fork Lower Willow Creek drainages. Some elk returned to calving range while others remained on Black Pine Ridge during the rut. Elk were distributed over winter, spring, and summer ranges during the fall.

One radioed cow elk (frequency 151.360, 3 yrs. old) was relocated along the East Fork of Rock Creek (about 3 miles due west of East Fork Reservoir) on 4 June. This location was about 22 miles south of her home range as documented in 1984. The elk was relocated along Upper Willow Creek, within its previously-documented home range, during the next relocation flight of 11 June. It is not known if this was an unusual movement for this elk, or an established movement pattern to a particular calving range.

Winter-spring elk trend counts have ranged from 230-415 in MDFWP hunting district 210 since 1979 (MDFWP Region 2 progress report, 1984-1985). Relocation data collected to date suggests that the principal elk population unit in this hunting district has established habitual movement patterns between the Rock Creek winter range and Black Pine Ridge summer range. The powerline and associated road network bisects the length of this population unit's yearlong range. Therefore, access and timber management along the powerline corridor may be expected to be important influences on the elk population and hunter opportunity in HD 210.

No relocations were in the Harvey-Eightmile study area proper in 1985, and only 3 relocations fell within the study area in 1984 (Hammond et al. 1985). However, summer-fall pellet group counts indicate that elk were found in the study area (Tables 3 and 6); these elk may constitute a separate population unit with distinct movement patterns, or they may be unsampled individuals within the currently-documented unit. An effort will be made in 1986 to radio-equip elk in the study area to document their movement patterns and evaluate their importance to the elk population of HD 210.

Seasonal Ranges (DeBorgia)

Relocation maps for the late-winter (April), spring (May-June), summer (July-August), rutting (September), and fall (8 October-5 December) seasons are presented in Appendix C. Radioed elk generally displayed similar movement patterns in 1985 as reported for the same elk in 1984 (Hammond et al. 1985); however, 12 elk were added to the radioed sample in 1985, providing an improved sample of elk movement patterns around the powerline corridor. Movement patterns of bulls were not noticeably different from those of cows; hence, relocation data for both sexes were lumped to delineate seasonal ranges.

Eight elk captured during the summer months at Rock Creek (Table 15, Figure 7) appeared to represent a distinct population unit. Winter range for all but one bull was located north of St. Regis in the Mullan Gulch, Mayo Gulch, and Tamarack Creek area. One spike bull apparently spent the winter on Clark Mountain (about 2 miles south of Thompson Falls). The spring migration corridor appeared to follow the powerline corridor to the Twelvemile Creek, Rock Creek, and McManus Creek drainages. The summer range was centered around Brooks Mountain and Flat Rock Creek (located about 10 miles northwest of the St. Regis winter range). Distribution was similar during the rut. Fall range was centered along the tributaries of Twelvemile Creek; elk use of the winter range increased with fall snow accumulations.

Five elk captured during the summer months near Meadow Mountain (Table 15, Figure 7) appeared to represent a second distinct population unit. These elk shared the St. Regis winter range with the Rock Creek population unit. Meadow Mountain elk also appeared to migrate along or near the powerline corridor in the spring. Summer ranges were centered on Cruzane Mountain and the CC Divide at the head of Packer Creek (located about 21 miles northwest of the winter range). Elk distribution appeared more scattered between Cruzane Mountain and the CC Divide during the rut, and more relocations were recorded at lower elevations near the powerline. This general distribution pattern continued through the fall; elk migrations along the corridor toward the winter range were evident as snow depths increased.

Five elk captured during the summer months along Randolph Creek near the Taft substation (Table 15, Figure 7) appeared to represent a third distinct population unit. Winter range for these elk was along Prospect Creek, about 5-10 miles south and west of Thompson Falls. Summer range for these elk was the Randolph Creek drainage (located about 6 miles south and southwest of the winter range). Two of the radioed elk moved north of the CC Divide to the Wilkes Creek and Dry Creek drainages during the rut, while the remaining three radioed elk were usually found along lower Randolph Creek. Distribution was similar in the fall, with increased migration toward Prospect Creek via Daisy Creek, Wilkes Creek and Dry Creek as snow accumulated.

Elk in the DeBorgia area appear to segregate into distinct summer-fall population units when they leave the winter ranges. Each population unit appears to be centered around a particular north-south oriented drainage

during summer and fall. The drainages with the highest densities of summer-fall elk relocations are the drainages where elk were trapped. Therefore, obvious gaps in summer-fall relocation data along Savenac Creek, Twin Creek, and the West Fork of Packer Creek may indicate the existence of unsampled population units. Hopefully, elk from any unsampled population units will be radio-equipped as a result of a cooperative elk trapping and marking effort being conducted in January-March 1986 by this study and the MDFWP Lower Clark Fork elk project.

The knowledge that the elk herd around DeBorgia is comprised of several population units has important implications for resource managers (Lyon et al. 1985, pp 3-4). Edge et al. (1985) found that elk did not leave traditional home ranges because of logging activities when extensive cover (such as that available in the DeBorgia area) remained available within their home ranges; hence, range expansion was not the first option utilized by elk to adapt to disturbances or habitat alterations. Instead, elk tended to concentrate in relatively favorable locations within their home ranges in response to disturbances elsewhere (Edge et al. 1985). This indicates that the manager must consider elk habitat requirements and management goals on a home range or population unit basis, rather than on the larger scale of the overall population. Inadequate elk security within the range of one population unit may not cause elk to move outside their home ranges for security before an overharvest (relative to management objectives) occurs (Lyon et al. 1985, p. 4). Management strategies should be tailored to meet specific goals for each population unit to avoid such problems.

The powerline corridor closely follows the fall migration route for elk that winter near St. Regis. Further, the powerline corridor and associated road system provides improved access to certain fall ranges of the three elk population units identified thus far in this study. Therefore, access and timber management along the powerline corridor may be expected to have significant impacts on elk harvests and hunter opportunity in the DeBorgia area.

Elk Habitat Security (DeBorgia)

The relative security of fall elk ranges in the DeBorgia area was evaluated by comparing the individual movement patterns of radioed elk immediately before and after opening day (27 October) of the 1985 elk hunting season. A total of 65 relocations of 16 radioed elk were recorded during 6 days between 8 and 26 October to document elk movement patterns in the fall before major hunting pressure began (Fig. 8). Weather conditions were characterized by overcast skies, frequent rain showers with light snow at the highest elevations, and morning temperatures ranging from 15°-40°F. Elk distribution was strikingly consistent during this period.

Radioed elk were relocated a total of 29 times during 4 days between 29 October and 7 November to monitor elk distributional responses to hunting pressure (Fig. 9). Weather conditions remained similar to those of the pre-hunting period; therefore, weather-induced movements that differred from the pre-hunting period were unlikely. Generally, individual elk distribution did not appear to change as a result of hunting pressure. The most notable change in individual elk distribution was observed for cow elk

B of the Rock Creek population unit. Six pre-hunting season relocations of elk B were concentrated within about 1 mi^2 along the Twelvemile Creek road (Fig. 8). Following opening day, elk B was found about 3 miles away along Rock Creek (Fig. 9). This movement probably was a response to hunting season traffic on the Twelvemile road (Table 13, Cabin City traffic count). Bull elk did not appear to respond differently to hunting pressure than cow elk (Figs. 8 and 9); however, bull elk number 4 was harvested on Clark Mountain on opening day.

Radioed elk were relocated a total of 33 times during 3 days between 12 November and 5 December to monitor elk movement patterns during hunting season as weather conditions changed (Fig. 10). Snow showers and morning temperatures of around 0°F were characteristic of this time period, and lower-elevation snow depths increased to about 12 inches by 1 December (Table 9). Generally, individual elk moved longer distances later in the hunting season, compared to movements monitored during the pre-hunting and early-hunting season periods. Rock Creek elk distribution shifted to the east of Twelvemile Creek, and movements to and from the winter range were recorded. Meadow Mountain elk moved more among concentration areas, and the radioed Meadow Mountain bull moved to winter range. Four of five Randolph Creek elk also moved toward winter range. The longer movements of individual elk during the latter part of hunting season probably were in response to increasing snow depths, since snow depth is probably the major factor influencing the timing and rate of fall elk migration (Adams 1982, p. 307). However, weather-induced movements also made elk more available to hunters, and more observations of elk were reported by hunters at the Rock Creek - Camel's Hump check station as elk movements increased. Therefore, observed fall migration patterns were probably modified by elk responses to encounters with hunters.

Irwin and Peek (1979) reported that hunters displaced elk in northern Idaho, but only 1 of 9 elk moved outside previously-known home range boundaries. Extensive cover and vehicular access restrictions reduced elk displacement during hunting season (Irwin and Peek 1979). Radioed elk in the DeBorgia area generally were not displaced by hunting pressure, except for one elk found along an open road system that received heavy hunting season traffic. Most roads that were open to vehicular traffic were located along drainage bottoms and at lower elevations, while elk selected upper slopes and ridgetops that were separated from open roads by steep topography and dense forests. This pattern of elk habitat selection occurred both before and during hunting season, indicating that elk may select such habitats in the absence of hunting pressure. Marcum et al (1984) also reported a strong preference by Chamberlain Creek elk for upper slopes during the rut and hunting season. Hunter reports at the Rock Creek - Camel's Hump check station early in the hunting season indicated that most hunters stayed very close to open roads and, therefore, seldom encountered elk or elk sign until weather influences caused increased elk movements. The current juxtaposition of open roads, topography, extensive forest cover, and elk concentration areas in the DeBorgia area resulted in an effective buffer between elk and hunting pressure until fall migration began.

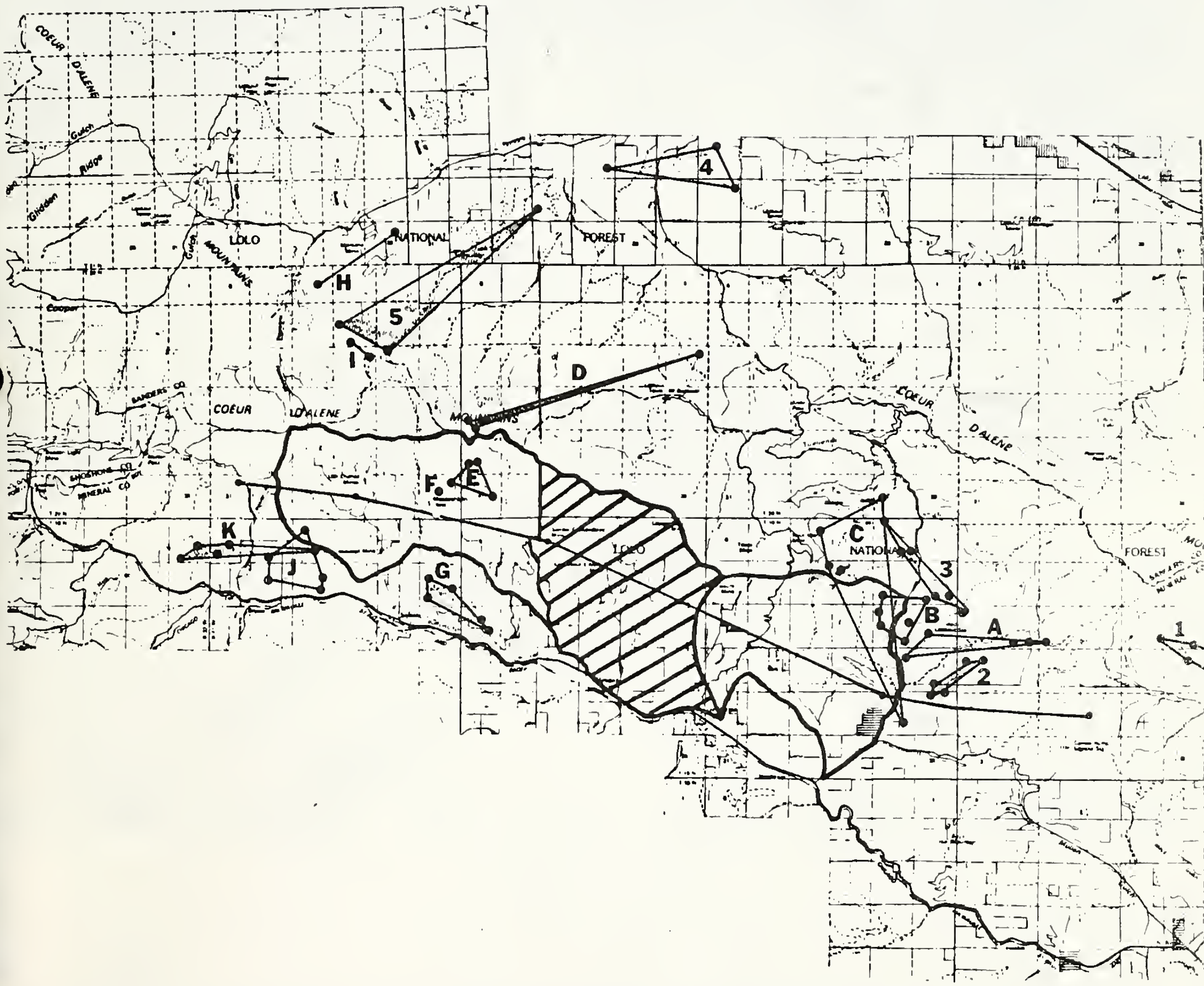


Figure 8. Individual home ranges of 16 radioed elk from 8-26 October 1985 (immediately before hunting season) near DeBorgia, Montana. Numbers represent radioed bulls and letters represent radioed cows.

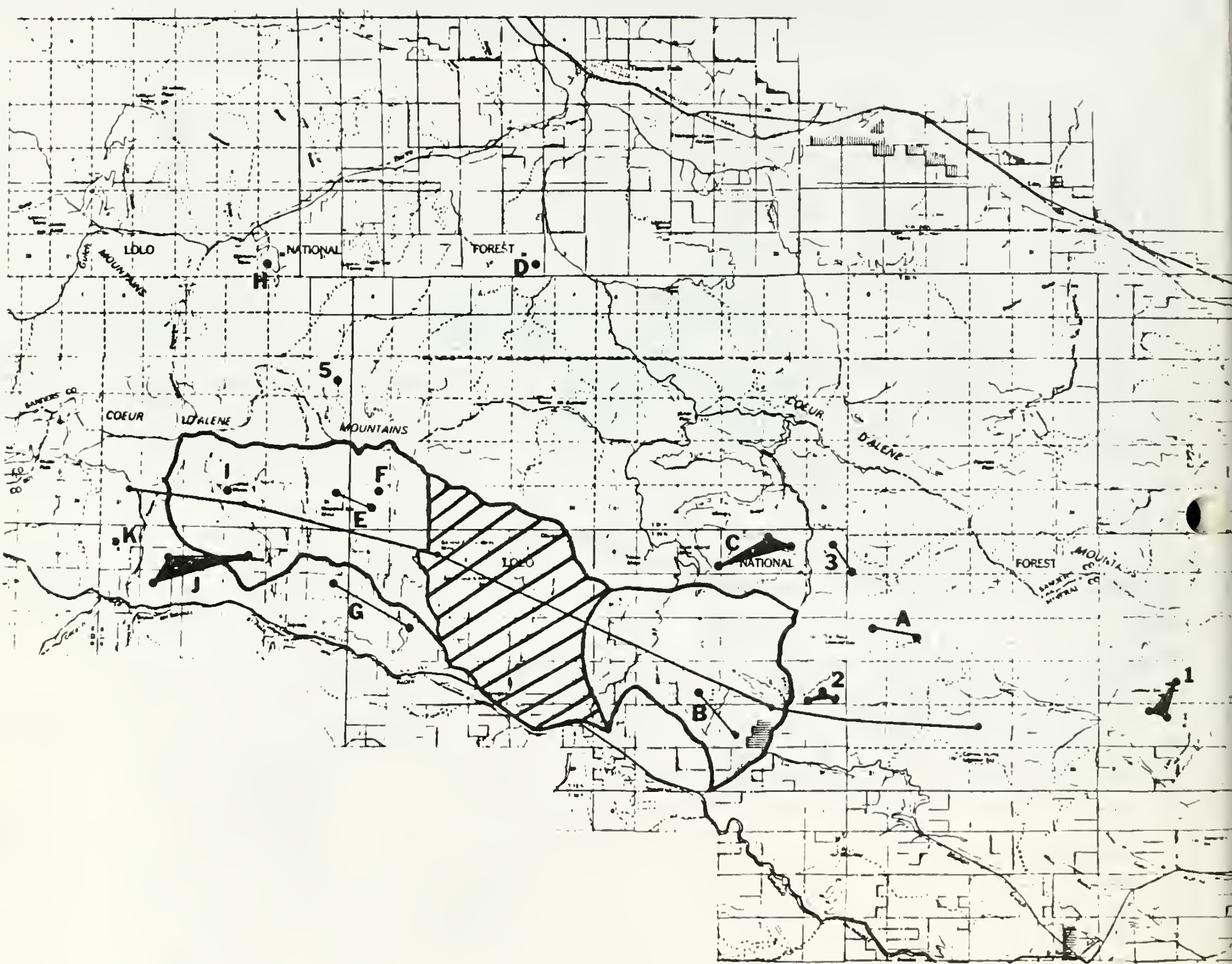


Figure 9. Individual home ranges or relocations of 15 radioed elk from 29 October-7 November 1985 (immediately after opening day of hunting season) near DeBorgia, Montana. Numbers represent radioed bulls and letters represent radioed cows.

Figure 10. Individual home ranges or relocations of 14 radioed elk from 12 November - 5 December 1985 (mid-late hunting season) near DeBorgia, Montana. Numbers represent radioed bulls and letters represent radioed cows.

Increased access and/or cover reductions on upper slopes and ridgetops would be expected to influence elk habitat security, based on fall relocation data. The powerline corridor and associated road network within the DeBorgia study area lies in the basin bottom separating the Osborne fault from the mountains adjacent to the St. Regis River. Although the new powerline access follows an elk migration route, it does not greatly improve hunter access to fall habitats selected by radioed elk within the study area proper. However, the impacts of the powerline access on elk habitat security may be expected to increase as the powerline climbs east of the study area to the ridgeline separating Mullan Gulch and Tamarack Creek. This area was particularly heavily-used by migrating Rock Creek elk during the last 2 weeks of hunting season. Vehicular access restrictions and cover retention are particularly appropriate management actions in this area to mitigate losses of elk habitat security.

Elk Habitat Security (Harvey-Eightmile)

Elk habitat security was not specifically evaluated using telemetry in the Harvey-Eightmile area because only three radioed elk were available as a sample by October. Plans for 1986 include the capture and radio-equipping of 10 additional elk in the Harvey-Eightmile area to provide an improved sample for evaluating elk habitat security in the hunting season of 1986.

10. Determine Fecal DAPA Levels

A total of 77 elk fecal pellet groups were collected and sent to Washington State University in 1984 for determination of fecal DAPA levels as an indicator of relative diet quality (Nelson et al. 1982). These data were not available by report time.

11. Monitor Construction and Compliance with Mitigation Measures

Waiver Requests

Powerline construction restrictions were imposed on contractors to mitigate the anticipated effects of construction disturbances on elk populations on winter and spring ranges. Contractors requested waivers of these restrictions when they wanted to work in a restricted area during a closure period. Generally, waiver requests were granted when elk were not present and were denied when elk were present in the closure area. This was a necessary and very time-consuming process in the interest of facilitating logistical problems that inevitably arose during construction while minimizing the stress on elk populations during a critical time of the year. The following analysis of the waiver request process was provided in a memo to the files from Larry Thompson (DNRC).

In the construction specifications for the Garrison West transmission project, 24 winter range restriction areas totalling about 63 miles in length were specified. An additional 2 miles of winter range closure were specified by BLM. The winter range closure period extended from December 1, 1984 through May 15, 1985. One calving area restriction was specified. This was the Silver King Ridge area, about 4.5 miles in length. The calving area restriction period extended from March 15 through July 15.

The following analysis is based on DNRC's waiver request correspondence file. Although this file contains 95 individual pieces of correspondence relating to the waiver requests, it may not be entirely complete in that some pieces of internal agency correspondence may be missing.

In all, 34 letters requesting waivers were sent. The first was dated November 9, 1984; the last, May 21, 1985.

It is very difficult to determine the precise number of individual waiver requests requiring a decision based on the correspondence file. Nearly every letter contains several individual waiver requests. Some of the requests were verbal and are not documented by correspondence. Some of the requests were repeated with slight variations in several letters and in undocumented telephone conversation. Some segments of line for which waivers were requested are adjacent or very close together. Whether these are to be considered as one request or as several independent requests is an arbitrary judgement. Ten requests were submitted by BPA and then withdrawn; these have not been included in the analysis. The best estimate is that 74 individual waiver request were made, 71 pertaining to winter range closures and three pertaining to the calving area closure.

Twenty-nine of the requests, or 39%, were entirely or partially denied. Of these, the number denied by the different agencies involved is as follows:

1	denied by USFS alone
1	partially denied by USFS alone
3	denied by DFWP alone
2	partially denied by DFWP alone
0	denied by BLM alone
0	denied by DNRC alone
3	jointly denied by USFS, DFWP, DNRC
11	jointly denied by USFS and DFWP
1	partially denied by USFS and DFWP
1	jointly denied by DFWP, BLM, USFS
1	denied by DFWP, later granted by DFWP
1	denied by DFWP, DNRC; later granted in part by DNRC, USFS, BLM
1	denied by DFWP but previously approved by DNRC
2	denied by USFS, granted by DFWP
1	denied by DFWP, granted by BLM, USFS

No documented action was taken on three requests.

All waiver requests were originated by BPA with the exception of one dated March 26, 1985, which was originated by the Deer Lodge National Forest.

Of the many areas along the line having timing restrictions, processing of waivers was most difficult along the segment between Flint Creek and the North Fork of Willow Creek (roughly between towers 21/1 and 32/1). This 12 mile long segment included about 2.3 miles of winter range closure on USFS land, about 2 miles of winter range on BLM land, and about 4.5 miles of calving area closure. Although this included only 12% of the total restricted area, 16 of the 74 waiver requests processed, or 22% concerned this area. Seven of the 16 requests (44%) were denied, although one of

these was later granted. The contractor repeatedly and frequently requested permission to enter this area, and not all these requests are reflected in the correspondence record and in the above statistics.

Toward the end of the winter range restriction period the contractor questioned whether or not elk were actually using the area, and numerous flights were made by state and federal biologists to determine elk distribution. In one case (request dated March 27, 1985), BLM granted access into this area but DFWP denied the request. On March 26, 1985, the USFS initiated a waiver request to allow setting of foundations and tower legs to allow helicopter erection of towers. This would eliminate the need for a crane pad in a very steep area. This request was later granted with a number of conditions regarding timing of vehicle movement through the area.

During the field investigation of the winter range area, it was discovered that an important calving area existed on private land to the east of the designated calving area. DFWP and DNRC were able to negotiate an agreement with BPA and the contractor to stay out of the area until after July 1.

The contractor was able to complete wire stringing in the calving area (between towers 29/4 and 32/3) by March 15, 1985, before the calving area timing restriction came into effect. On March 18, 1985, however, 5 towers (numbers 27/2 to 28/3) were damaged when a buried log used to secure the conductors pulled out. Towers 28/1-28/3 were within the calving area closure. On June 5, BPA made a verbal request to allow a construction crew to work on these damaged towers. DFWP originally denied this request because elk were present in the area, but the request was granted on June 12 when field inspections revealed that elk had moved out of the area.

On May 16, 1984, DNRC suggested a notification procedure for processing of closure area waiver requests (Kevin Hart letter to Phil Havens). However, the notification and response procedure did not work smoothly and efficiently, and points of contact were not well-established, until well into the study. Between November 9, 1984, and February 22, 1985, twenty-one different people were sending and receiving correspondence regarding the waiver requests. For example, correspondence was sent or received by four different DNRC representatives--from the technical specialist to the deputy director--and by six different DFWP representatives--from field biologists to deputy director--during this period. By mid-March, however, a more efficient channel of communication developed, and for the most part all correspondence was channeled through the designated liaison for each agency. In the interest of improving efficiency of such communication in future projects, this fairly successful system is documented by means of a somewhat idealized diagram (Fig. 11).

Recommendations for future projects include the following:

(1) A liaison for each agency should be identified at the beginning of the project and all written communication should be channeled through that person.

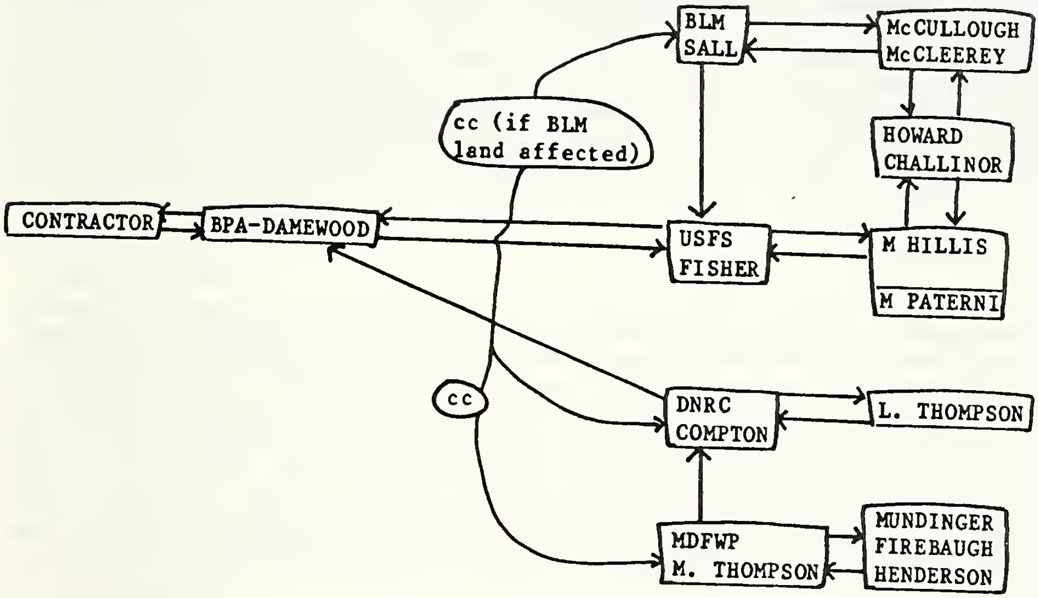


Figure 11. Communication channels for initiating and responding to waiver requests of powerline construction restrictions on public lands in western Montana, 1985.

(2) All requests and responses, without exception, should be documented in writing.

(3) Each piece of correspondence should specify (a) the construction schedule involved (e.g., Schedule IV), (b) the tower numbers involved (e.g., 21/1-22/4), and (c) in the case of responses, the date and author of the waiver request to which the letter is responding.

(4) Each waiver request should include, in addition to the above, an explanation of the need for the waiver, the proposed schedule of activity in the restricted area, and a description of the type of equipment and number of people involved.

(5) Tower numbers (e.g., 21/1-22/4) should be used to describe each segment of line discussed. The correspondence file is full of references to "Rock Creek area," "Smart Creek to F.S. Road #378", "5623+00-5875+25", and similar references. These are extremely hard to keep track of and to correlate with other requests described by tower numbers.

Road Closures

Several days were spent inspecting road closures that were implemented along the powerline to mitigate the impacts of increased road access. Inspection efforts were concentrated in the Flint Range, the Ellis Mountain area, and the two study areas. Two open gates during closure periods on Ellis Mountain were reported to the Ninemile Ranger District and BPA. Subsequent inspections confirmed that the gates were closed. It was noted that extensive mining roads and jeep trails in the Flint Range were obstructed where they intersected the new powerline access roads; hence, mining roads did not provide access to the powerline road system behind closed gates. In addition, the Superior Ranger District obliterated a spur road at our request when it was found that the previous barricade had been vandalized.

Monitoring of mitigation measures in the Harvey-Eightmile area revealed that the planned obliteration of a portion of the Harvey-Eightmile tie-through road would not be an effective, long-term barrier to recreational traffic. This tie-through road was constructed to facilitate the powerline project and connects two previously discontinuous road systems in elk habitat. An open tie-through road would encourage higher-than-previous traffic flows through an elk security area and would reduce hunter opportunity in the area (Interagency Mitigation and Monitoring Plan 1983). One obliteration attempt by construction contractors was inspected and found inadequate. Finally, an interagency field inspection resulted in practical specifications for an effective obliteration.

12. Participate in Forest Service Project Planning

Forest Service Interdisciplinary (ID) Team

The project biologist participated as a Forest Service ID team member for two proposed timber sales (Randolph Creek and Keystone Ridge) located along the powerline in the Superior Ranger District. Roads built for the powerline project will supplement access to these timber sales. Telemetry data from this study pertaining to the Randolph sale was presented to the ID team. Radio relocations indicated that the southern half of Taft Peak is an important concentration area for the Randolph Creek elk population unit during summer and fall (Appendix C). This concentration area currently is non-roaded and is rugged topographically; however, Interstate 90 and the Randolph Creek road run along the base of Taft Peak, less than 1 mile from the concentration area. Any new roads in the concentration area could not simply be gated to effectively maintain elk security because of the area's close proximity to major roads; new roads would greatly improve hunter access by foot and horseback. Therefore, it was recommended that no new roads be built for logging on the southern half of Taft Peak to maintain habitat security for the Randolph Creek population unit. Meetings will continue in 1986.

Road Management

Input was provided to the Superior Ranger District at their request concerning use of BPA-constructed roads on Forest Service land to provide access for a private timber sale north of DeBorgia. The logging would occur on private land, but the loggers requested to haul logs on new powerline-access roads through the lower Rock Creek drainage in the DeBorgia study area. It was recommended that use of the Rock Creek roads be permitted only from 1 December-30 April since elk do not use the area during that time; therefore, hauling traffic would not violate the disturbance controls necessary for this study. The Forest Service permitted hauling traffic on the Thompson-DeBorgia road as an equitable alternative.

Hawk-Packer Timber Sale

Input was provided to the Superior Ranger District at their request concerning the Hawk-Packer timber sale in the DeBorgia study area. Hawk-Packer is a timber sale that poses logistical problems in the design and interpretation of the results of this study. Roads for the sale were built in 1984, and the sale was inactive in 1985. The Forest Service is buying the sale back from Washington-Idaho Co. and proposes to re-sell it in two portions; only the first portion could affect this study.

The first sale is a seed tree removal from six cutting units between Timber Creek and Packer Creek. The Forest Service proposed to do this as soon as possible to minimize the damage to regeneration by the logging operation. Concurrent plans for this study were: (1) monitoring of spring-summer-fall elk distribution in the absence of construction activity through 1986 using pellet transects, and (2) identification and description of elk security areas using radio telmetry through 1987. Therefore, it was agreed that

logging activity will be restricted to the following time periods: 1 December 1986-31 March 1987 and/or 1 July-1 October 1987. This facilitates reading pellet transects in June 1987 (to monitor elk distribution during October-November 1986), it eliminates logging disturbances in spring-summer-fall 1986, and it restricts summer logging in 1987 to a time when elk are on higher-elevation ranges away from the cutting units (based on relocation data). Therefore, the Hawk-Packer sale will not further impact the results of this study.

13. Participate in USFS Forest Planning Process

Radio relocation data for the Harvey-Eightmile elk population unit were presented to Deerlodge National Forest personnel and incorporated in the planning process for that area. Management area designations (from the draft Forest Plan) were reviewed within the spring-summer-fall range of this population unit. Results of this study indicated that proposed timber management along the eastern slope of Black Pine Ridge from the North Fork of Lower Willow Creek to Silver King Ridge would reduce elk security and ultimately affect hunter opportunity. It was agreed that the final Forest Plan should mandate greater consideration for elk security and hunter opportunity along the eastern slope of Black Pine Ridge, and an alternative management area designation was recommended for certain timber management areas. The Forest Plan continues to undergo review at this writing.

14. Implement Road Closures Through Participation in USFS Travel Planning Process

Road closures in addition to those specified and maintained according to current Forest Service travel plans were not recommended in 1985.

15. Determine Project Impacts

Construction Disturbance

The impacts of powerline construction activity on elk distribution (as indicated by pellet counts on summer-fall ranges) were greatest during hunting season in 1984, when elk were displaced in 2 of 4 study zones. Elk may have reacted more strongly to construction traffic in hunting season if elk associated that activity with hunting. Monitoring of hunting season elk distribution in 1985 (based on pellet counts in June-July 1986) and 1986 will provide for assessment of: (1) the persistence of elk displacement and (2) the effectiveness of public road closures in the absence of construction activity.

Elk population units in the two study areas increased their usage of summer-fall habitats along the powerline during hunting season, based on radio telemetry data. Population units in the DeBorgia area used powerline-influenced habitats when migrating to winter ranges during the hunting season of 1985. This documented tendency for elk to move toward powerline-influenced habitats in and around the two study areas during hunting season indicates that powerline construction disturbances influenced population units, rather than merely a few individual elk, in the 2 study zones where elk were displaced. Again, the persistence of this

impact and the effectiveness of public road closures in the absence of construction activity in future hunting seasons will determine the extent to which population management and hunter opportunity will be influenced.

The impacts of powerline construction activity on elk distribution were minimal during winter and spring, since construction was not permitted on important winter-spring ranges during periods when elk concentrations were present. Additionally, BPA cooperated with MDFWP, DNRC, and BLM in delaying construction activity on a spring range that was not protected by contract specifications.

Elk Habitat Security

Results of this study suggest that the increased access provided to hunters by the powerline project contributed to an increased harvest of spike bulls in HD 210 in 1984. This occurred despite the implementation of road closures to mitigate for reductions in elk habitat security. Road closures may cause an increased harvest because hunters spend more time walking and consequently see more elk (Lyon et al. 1985). Therefore, it is not surprising that the construction of the powerline road system through elk habitat increased the vulnerability of elk to hunting. This could lead to more restrictive hunting regulations and reduced hunting opportunity if this impact persists.

Telemetry studies in the DeBorgia area (HD 200) indicated that effective elk habitat security remained adjacent to the powerline corridor in 1985. Hunters generally remained close to open roads, and those roads were separated from security areas by steep slopes and extensive forest cover. However, increasing snow depths during hunting season caused elk to leave fall security areas and increased their vulnerability to hunting. Road and cover management along the powerline between Twelvemile Creek and the St. Regis winter range is especially important to provide security for elk along that major migration route.

Access for Timber Harvest

The powerline road system provides improved access to elk habitat for timber harvest as well as for hunting. Powerline project roads provide supplementary access to two timber sales proposed in 1985 in the Superior Ranger District. Further, the powerline road system provided the preferred route to and from a private logging operation in the Superior District. Timber sales specifically designed to take advantage of the powerline corridor and road system may be expected in the Deerlodge National Forest (21 May meeting with MDFWP, Missoula). This interest in using the powerline road system for timber harvest magnifies the potential impacts of the powerline project on elk habitat security and hunter opportunity. Mitigation measures to minimize these cumulative impacts will be devised and recommended as a result of this study after more data are collected.

Variability of Project Impacts

The greatest impact of the powerline project on elk and elk hunting opportunity results from the presence of new access roads in previously unroaded security areas. However, the extent of new access roads is variable along the length of the line, depending upon the availability of previously-constructed roads along the powerline route. More miles of new roads were required in areas with previously low road densities than in previously heavily-roaded areas. Therefore, the number of miles of new roads constructed per mile of powerline is an index of previous accessibility, as well as a measure of increased road mileage. This statistic was calculated for each of 13 consecutive segments of the powerline corridor from Garrison-Taft, using information on BPA road mileage provided by the Lolo National Forest (Table 18). Each segment represents relatively homogenous conditions relative to the extent of new road construction and previous roading. Reconstruction of existing roads by BPA was not considered in this analysis.

Table 18. Miles of newly-constructed BPA access roads per mile of powerline corridor for 13 segments of the corridor from Garrison-Taft, Montana.

Segment	Location	Length	Mi. New Road/ Mi. of Powerline
1.	Garrison - Eureka Ridge	8 mi	1.375
2.	Eureka Ridge - Flint Cr.	7.5 mi	2.613
3.	Flint Cr. - Gaylord Gul.	5.5 mi	2.236
4.	S. Fk. Lower Willow - Brewster Tyler	12 mi	1.892
5.	Brewster - Tyler - Rock Cr.	10 mi	0.970
6.	Rock Cr. - Davis Point	11 mi	0.700
7.	Blue Mtn. - Deep Cr.	21 mi	0.371
8.	Deep Cr. - Clark Fork	11 mi	0.609
9.	Clark Fork - Nemote Cr.	10 mi	2.41
10.	Nemote Cr. - Johnson Cr.	16 mi	0.688
11.	Johnson Cr. - Clark Fork (St. Regis)	11 mi	1.082
12.	Clark Fork - Cabin City	11 mi	1.736
13.	Cabin City - Taft	17 mi	1.294
		151 mi	

Less than one mile of new road was constructed per mile of powerline in the segments closest to Missoula, reflecting the previously high road densities of these areas (Segments 6, 7 and 8). Similarly, relatively little new road construction was required for powerline access in the previously-logged segments from Nemote Creek to St. Regis (segments 10 and 11). Previously high road densities resulted in relatively little new road construction in these areas; hence, it appears that the accessibility of these areas was not greatly increased as a result of powerline access. Therefore, powerline project impacts on elk security and hunting opportunity in these areas may be reduced compared to other segments of the powerline corridor.

Current studies are focused in 5 of the remaining 8 segments. These are segments 3, 4, and 5 in the Harvey/Eightmile study area, and segments 12 and 13 in the DeBorgia study area. The study areas were selected to include large blocks of previously unroaded habitat, as reflected by the relatively high mileage of new roads constructed in these segments (Table 18).

The two segments with the greatest mileage of new access roads (over 2.4 miles of new roads per mile of powerline) are not included in the study plan for monitoring of their associated elk herds. Both of these segments (segments 2 and 9) provide habitat that is occupied by elk populations during hunting season, depending upon weather conditions. Therefore, impacts of the powerline project on elk populations and hunter opportunity should be expected in these areas, as well as in the current study areas. Elk population units, seasonal ranges and security areas should be idenfified to provide a basis for developing effective mitigation measures in these areas.

16. Determine Magnitude of Unmitigated Impact

This will require an assessment of long-term impacts later in this study.

17. Recommend Measures to Offset Unmitigated Project Impact

Not applicable in this report period.

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Joslin, G. 1985. Montana Mountain Goat Investigations - Rocky Mountain Front, Mont. Dep. of Fish, Wildl. and Parks, Helena, 212 pp.

Lonner, T.N. and J.D. Cada. 1982. Some effects of forest management on elk hunting opportunity. Proceedings of the Western States Elk Workshop, Flagstaff, Arizona. pp 119-128.

Lyon, L.J., T.N. Lonner, J.P. Weigand, C.L. Marcum, W.D. Edge, J.D. Jones, D.W. McCleery, and L.L. Hicks. 1985. Coordinating elk and timber management. Final report of the Mont. Coop. Elk-Logging study - 1970-1985. 53pp.

Marcum, C.L., W.D. Edge, M.D. Scott, J.F. Lehmkuhl, and S.L. Olson. 1984. Final report of the Chamberlain Creek elk study: 1975-1984. School of Forestry, University of Montana, Missoula, 257 pp.

Marcum, C.L., and M.D. Scott. 1985. Influences of weather on elk use of spring-summer habitat. J. Wildl. Manage. 49:73-76.

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Pfister, R.D., B.L. Kovalchik, S.F. Arno, and R.C. Presby. 1977. Forest habitat types of Montana. Intermountain Forest and Range Exper. Station, U.S.D.A., Ogden, UT. 174 pp.

Thompson, M.J. 1981. Mountain goat distribution, population characteristics and habitat use in the Sawtooth Range, Montana. M.S. Thesis, Montana State Univ., Bozeman. 79 pp.

USDA Forest Service, USDI Bureau of Land Management, State of Montana, USDOE Bonneville Power Administration. 1983. Garrison-Spokane 500kv Transmission Project; plan for mitigation and monitoring. Portland.

Appendix A. Annotated bibliography of selected literature reviewed in 1984-1985.

Canfield, J.E. 1984. Elk habitat use and the impact of the construction and energization of a 500-kv AC powerline on the North Boulder Winter Range, Montana. M.S. Thesis, Montana State Univ., Bozeman, 130pp.

Elk habitat use, activity patterns, and winter distribution, before and after energization of a 500-kv AC powerline which crosses critical winter range in southwestern Montana, was studied during the mild winters of 1983 and 1984. Powerline construction in the spring of 1983 displaced radioed elk prior to spring migration. The physical presence of the powerline did not alter elk distribution or activity patterns; however, noise generated from corona discharge off the conductors during precipitation caused elk to hesitate and show excitability before crossing a "noisy corridor", and may alter basic elk daily activity patterns during storms.

Clutton-Brock, T.H., F.E. Guinness, and S.D. Albon. 1982. Red Deer: behavior and ecology of two sexes. University of Chicago Press, Chicago. 378pp.

Red deer behavior is documented and explained in an evolutionary context relative to reproductive performance.

Collins, W.B. and P.J. Urness. 1979. Elk pellet group distributions and rates of deposition in aspen and lodgepole pine habitats. Pages 140-144 in M.S. Boyce and L.D. Hayden-Wing, eds. North American Elk: ecology, behavior and management. Univ. Wyoming.

Results showed significant differences between pellet-group distributions and actual distributions of elk activity. The distribution of pellet groups did not give accurate representation of relative habitat segment use. Roughly 40 percent of all defecations occurred as the animals were traveling, yet traveling represented only 3.5 to 5.6 percent of the elk day.

Davitt, B.B. and J.R. Nelson. 1984. Methodology for the determination of DAPA in feces of large ruminants. Western states and provinces elk workshop. Edmonton, Alb.

A standardized technique has been developed for monitoring DAPA (2, 6 diaminopimelic acid) in feces from elk and other large ruminants for use as an index of herd nutritional well-being. DAPA profiles for various big game herds may be useful in evaluating: (1) habitat suitability, (2) manipulation effectiveness, (3) interspecific competition on a nutritional basis, and, possibly, as an animal criterion in (4) long-term big game range condition and trend studies. With additional data, DAPA patterns might be useful in (5) predicting herd productivity and mortality.

Edge, W.D., C.L. Marcum, and S.L. Olson. 1985. Effects of logging activities on home-range fidelity of elk. J. Wildl. Manage. 49:741-744

Thirty-nine cow elk were radiotracked for two or more complete field seasons between 1977 and 1983. Thirty-one elk were tracked for two consecutive years during which one year had logging disturbance within the

home range. Mean home range size did not vary with disturbance. Elk continued to display fidelity to their home ranges during activity, but left impacted areas and moved to more secure portions of the home range. Logging activities that are restricted as much as possible in time and space, or conducted on seasonal ranges during periods when elk are not present, will be least disruptive.

Greer, K.R. and H.W. Yeager. 1967. Sex and age indications from upper canine teeth of elk (Wapiti). J. Wildl. Manage. 32(3): 408-417.

Describes a method to determine age and sex of elk from upper canine teeth. Calves, yearlings, 2-year olds, 3-7 year old age group and 8 years and older were recognizable.

Irwin, L.L. and J.M. Peek. 1979. Relationship between road closures and elk behavior in northern Idaho. Pages 199-204 in M.S. Boyce and L.D. Hayden-Wing, eds. North American elk: ecology, behavior and management. Univ. Wyoming.

General areas of elk use, as well as habitat selection within those areas during the hunting season, appeared to be governed primarily by previous traditions and social behavior associated with the rut. Hunters displaced elk from preferred areas to areas of similar but more extensive habitat. Although hunters displaced elk, 8 of 9 radioed elk remained within known home range boundaries. Road closures allowed elk to remain longer within preferred areas.

Knight, R.R. 1970. The Sun River elk herd. Wildl. Monogr. No. 23. Washington D.C.: The Wildlife Society. 66pp.

Details migration, population characteristics, habitat selection and food habits of the Sun River elk herd.

Kuck, L., G.L. Hompland, and E.H. Merrill. 1985. Elk calf response to simulated mine disturbance in southeast Idaho. J. Wildl. Manage. 49(3): 751-757.

Radio-collared cow/calf elk pairs were sensitive to human and simulated mine disturbance during calving and calf rearing. Initially, following a disturbance, cow/calf pairs tended to return to the calf-rearing area several days after being disturbed. Repeated disturbance resulted in abandonment of the calf-rearing area and increased use of marginal habitats compared with undisturbed cow/calf pairs. Abandonment of the calf-rearing areas did not result in abandonment of calves, and calf survival rates did not differ between control and disturbed calves. Long term impacts of altered habitat selection on herd productivity and survival rates were not investigated.

Leege, T.A. 1984. Guidelines for evaluating and managing summer elk habitat in northern Idaho. Wildl. Bul. No. 11. Idaho Dept. of Fish and Game. 37pp.

Details information on seasonal habitat preferences and food habits of elk during spring, summer and fall months. Recommendations are made for coordinating logging, road construction and livestock grazing with elk

habitat management. An evaluation procedure for estimating the effects of proposed land management activities on the quality of elk habitat is presented.

Loft, E.R. and J.W. Menke. 1984. Deer use and habitat characteristics of transmission-line corridors in a Douglas-fir forest. J. Wildl. Manage. 48:1311-1316.

A transmission-line corridor in mature Douglas-fir forest on the winter range of black-tailed deer was evaluated as deer habitat in northern California. Openings created for the transmission line were more attractive to deer in winter than was the forest. Plots with highest deer use had low tree canopy closure and high cover of deerbrush, total herbaceous vegetation, blackberry, and total shrubs.

Lonner, T.N. 1976. Montana Cooperative Elk-Logging study. Job II-B, Long Tom Creek Study. pp. 15-56. Prog. Rep. January 1 - December 31, 1975. 81pp.

Describes the pellet group transect methodology.

_______________ and J.D. Cada. 1982. Some effects of forest management on elk hunting opportunity. Proc. Western States Elk Workshop, Flagstaff, AZ.

A model was developed based upon the relationship between habitat security, elk harvest rate, effective season length and recreational opportunity. Hiding cover provided by trees and the density of open roads were assumed to be the major determinants of elk habitat security. Hunting recreational opportunities were assumed to be good when hunting season lengths are relatively long, harvest rates are uniform, and rules and regulations few. As habitat security decreases, harvest rate in the first week of hunting season increases, effective season length decreases, and recreational opportunity also decreases. Road closures do not compensate completely for the loss of security because access is improved for foot travel, horses, motorbikes and snowmobiles.

Lyon, L.J. 1976. Elk use as related to characteristics of clearcuts in western Montana. pp. 69-72. <u>In</u> Proc. Elk-Logging-Roads Symposium. Univ. of Idaho, Moscow.

Elk use of clearcuts, as indicated by pellet groups, is determined by the size and age of the opening but is also strongly influenced by the amount of slash and down timber in and around the opening. Openings of 10-40 acres appear to be more acceptable to elk on summer ranges.

_______________ 1979. Habitat effectiveness for elk as influenced by roads and cover. J. For. 77(10): 658-660.

Pellet counts confirmed that elk tend to avoid habitat adjacent to open forest roads. The area avoided increases where the density of tree cover is low. Describes a method for determining the losses of effective habitat.

_____________ 1979. Influences of logging and weather on elk distribution in western Montana. U.S.D.A. For. Serv., Res. Pop. INT-236, Ogden, Utah, 11pp.

The single most important influence on elk distribution was weather. The second determinant of elk distribution was logging. Recommendations intended to reduce the time during which habitat is unavailable to elk are presented.

_____________ and C.E. Jensen. 1980. Management implications of elk and deer use of clear-cuts in Montana. J. Wildl. Manage. 44: 352-361.

Pellet distributions suggest that animals enter clear-cut openings in search of better quality or quantity of forage. Use was greatly influenced by adjacent security cover. Elk use of clear-cuts was severely depressed by the presence of open roads.

_____________ 1983. Road density models describing habitat effectiveness for elk. J. For. Sept.: 592-595.

Describes models depicting elk response to changes in the density of forest roads.

_____________ T.N. Lonner, J.P. Weigand, C.L. Marcum, W.D. Edge, J.D. Jones, D.W. McCleery, and L.L. Hicks. 1985. Coordinating elk and timber management. Final report of the Montana Cooperative Elk-Logging study 1970-1985. 53pp.

Recommendations and management guidelines are given regarding timber harvest, road construction, road design, road management and area closures. Details information concerning elk behavior and habitat requirements within the existing physical environment (security, shelter, food and water).

Marcum, C.L. 1975. Summer - Fall habitat selection and use by a western Montana elk herd. Ph.D. dissertation, Univ. of Montana, Missoula. 188pp.

Describes habitat selection by elk with respect to vegetation, weather, slope, elevations, overstory canopy cover, proximity to water, and openings. Areas within 550 yards of open system roads and clearcuts were used significantly less. Elk were displaced by logging activities.

_____________ W.D. Edge, M.D. Scott, J.F. Lehmkuhl, and S.L. Olson. 1984. Final report of the Chamberlain Creek elk study: 1975-1984. School of Forestry, University of Montana, Missoula, 257 pp.

Elk distribution, movements, and habitat use before, during, and after logging on summer range in the Garnet Mountains of western Montana are reported. This was determined from pellet-group counts along belt transects and from radio telemetry data. Discussion of habitat selection was based on telemetry data rather than pellet-group distribution because the latter technique may be valid only for course-grain habitat evaluations. The level of human activity and annual precipitation affected elk distributions and habitat use. Two elk herds with low rates of dispersal and interherd movements were found to use the area. Recommendations are detailed.

______________ and M.D. Scott. 1985. Influences of weather on elk use of spring-summer habitat. J. Wildl. Manage. 49:73-76.

Measurement and prediction of changes in elk distribution and habitat use patterns caused by human activities require the ability to quantify variations caused by other factors, including weather. In this study, observed yearly differences in elk distribution and habitat use were likely the result of direct and indirect weather influences. Erroneous conclusions concerning the influence of human activities on elk distribution on summer range would be possible if one year of predisturbance data were obtained during a dry year, followed by disturbance data during a wet year.

Morgantini, L.E. and R.J. Hudson. 1985. Changes in diets of wapiti during a hunting season. J. Range Manage. 38(1): 77-79.

Elk distribution patterns on winter range were altered as a result of hunting pressure, resulting in significant changes in elk food habits.

Neff, D.J. 1968. The pellet-group count technique for big game trend, census, and distribution: a review. J. Wildl. Manage. 32:597-614.

Observer bias arises mainly from differences in interpretation and from missed groups. Missed groups error is influenced by plot size and shape, type and density of understory vegetation, and observer fatigue and inherent visual acuity. Sources of interpretational differences include decisions concerning peripheral groups, scattered groups, and the minimum number of pellets to be counted as a group. Pellet group counts have been unworkable at times because of rapid loss of pellets by insect attack or heavy rains, because of difficulties in identifying pellets of different species, or because of extremely dense vegetation. It is generally agreed that long narrow plots are superior to shorter wider plots. Pellet-group sampling is more efficient in areas of high pellet-group density. It is assumed that pellet groups are deposited most heavily in those places in which big game spend the greater part of their time. Pellet-group counts are widely used for indicating habitat preferences, yet the relationship between defecation and other animal activities remains conjectural.

Peek, J.M., M.D. Scott, L.J. Nelson, D.J. Pierce, and L.L. Irwin. 1982. Role of cover in habitat management for big game in northwestern United States. Trans. North Am. Wildl. and Nat. Resour. Conf. 47: 363-373.

The interaction of forage quality and quantity with precipitation and snow depth, and the effect that cover has on the interaction, confounds attempts to isolate the need for cover solely from field observation. Further, habitat preference or selection, and habitat requirement may not be equivalent. Habitat use patterns vary with different population densities; hence, interpretation of habitat preference must include an evaluation of characteristics of the population inhabiting the area in consideration.

Roberts, H.B. 1974. Effects of logging on elk calving habitat. U.S. Government Printing Office - 679-886/152 Region No. 8. 23pp.

An elk calving area in central Idaho was logged according to a plan that was intended to account for the requirements of the elk herd. A monitoring program was designed and implemented to (1) determine the extent of the calving areas, (2) make needed modifications to the sale layout, and (3) followup to determine what effects logging and road construction had on this elk population. Key areas were located and protected by preserving timbered buffers. Roads were kept away from natural openings and other key areas. Logging activity was not permitted near the calving area when cows and calves were present. It was concluded that elk were not negatively impacted as a result of the mitigation efforts.

Rost, G.R. and J.A. Bailey. 1979. Distribution of mule deer and elk in relation to roads. J. Wildl. Manage. 43: 634-641.

Responses of deer and elk to roads were assessed by counting fecal pellet groups. The authors concluded that deer and elk avoid areas within 200 m of a road. Road avoidance was greater for deer, when compared to elk.

Thomas, J.W. and D.E. Toweill, ed. 1982. Elk of North America: ecology and management. Stackpole Books. Harrisburg, PA. 698pp.

A compendium of elk research. Chapters include, but are not limited to, elk physiology, behavior, habitats, nutritional requirements, relationships to other species, limiting factors, population dynamics, migration and management.

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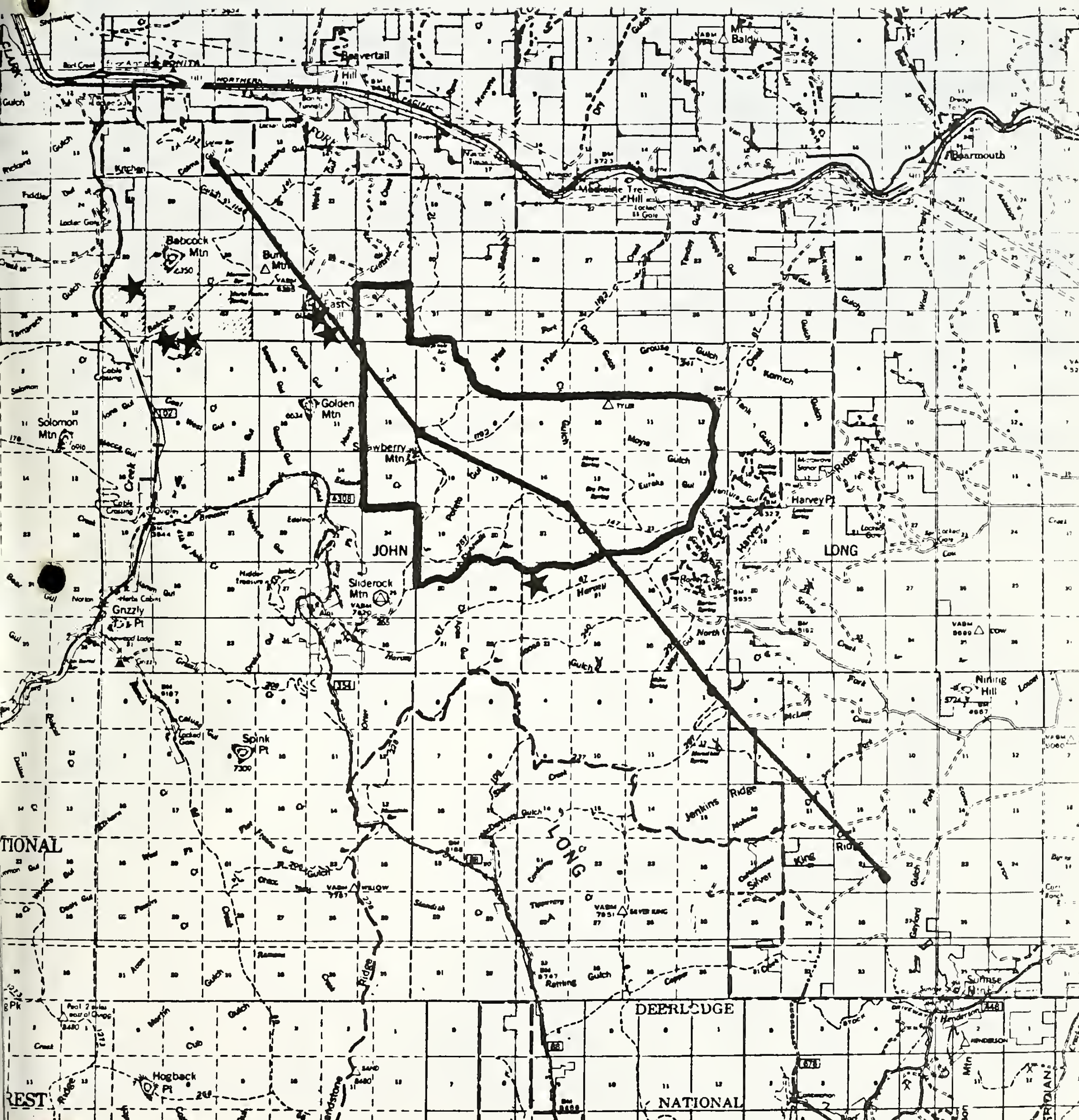
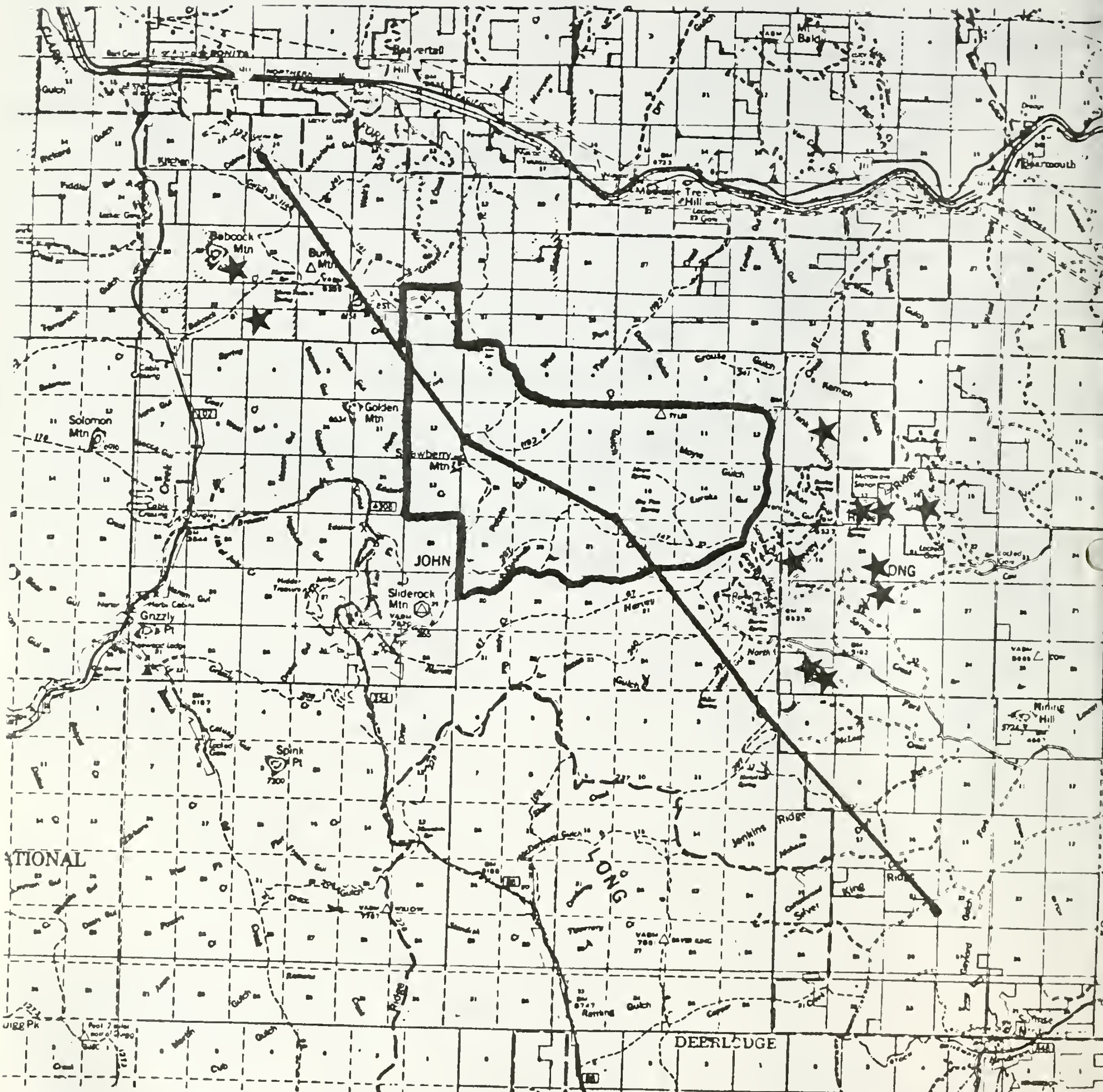
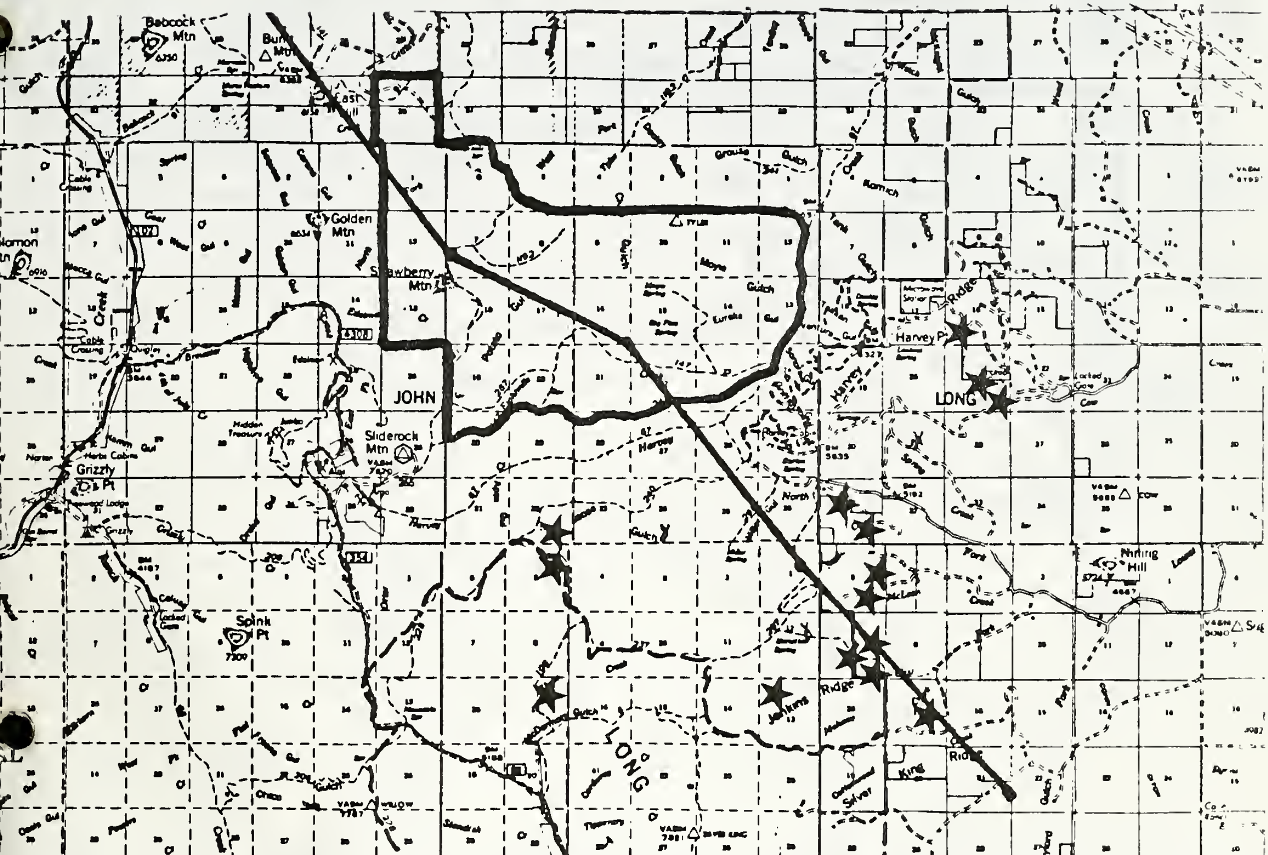
Appendix B - Relocation maps for radioed elk in the Harvey-Eightmile area, 1985.



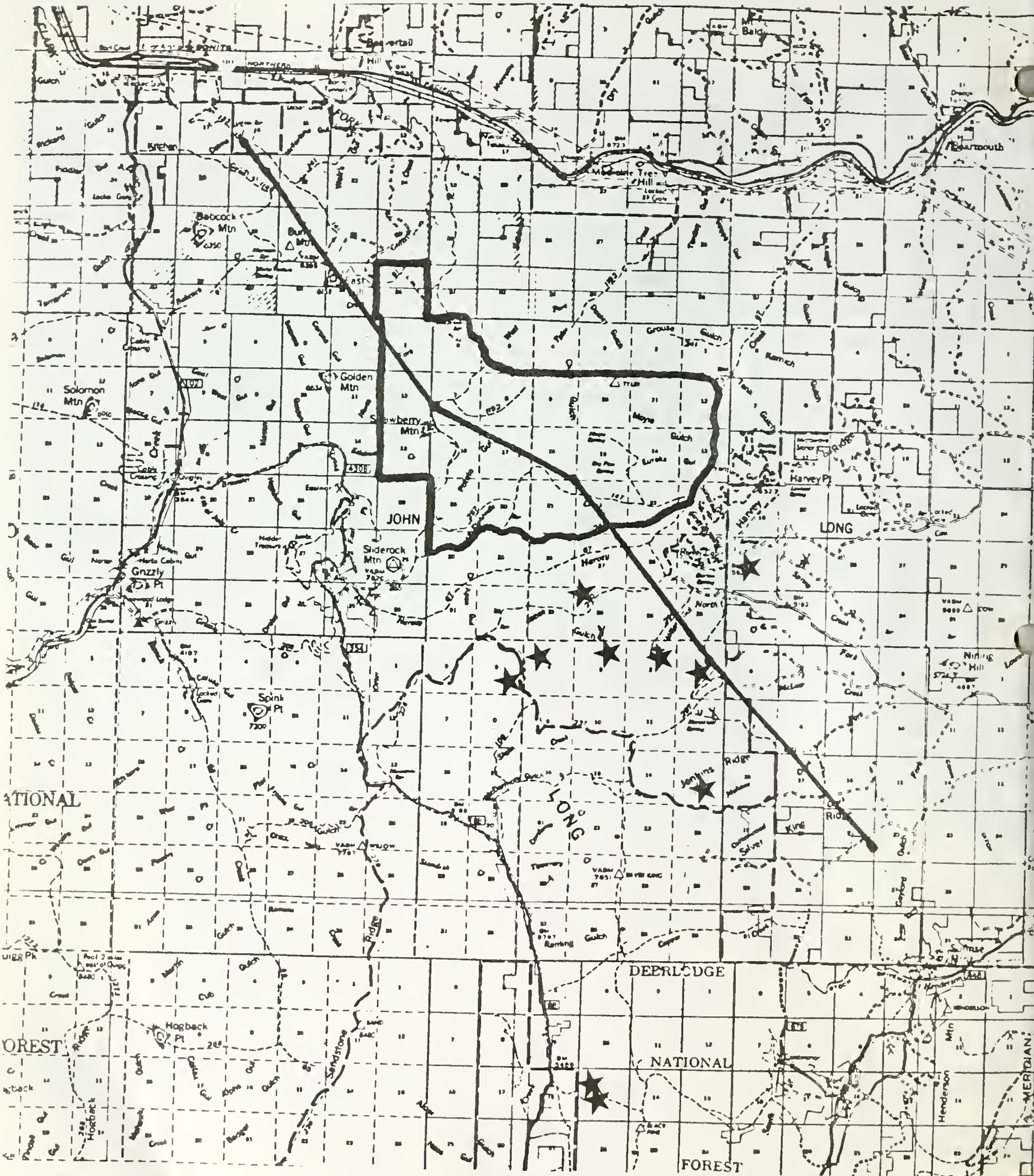
Relocations of six radioed elk in the Harvey-Eightmile area, Montana, 14 January, 1985. The powerline and study area boundary are also shown.



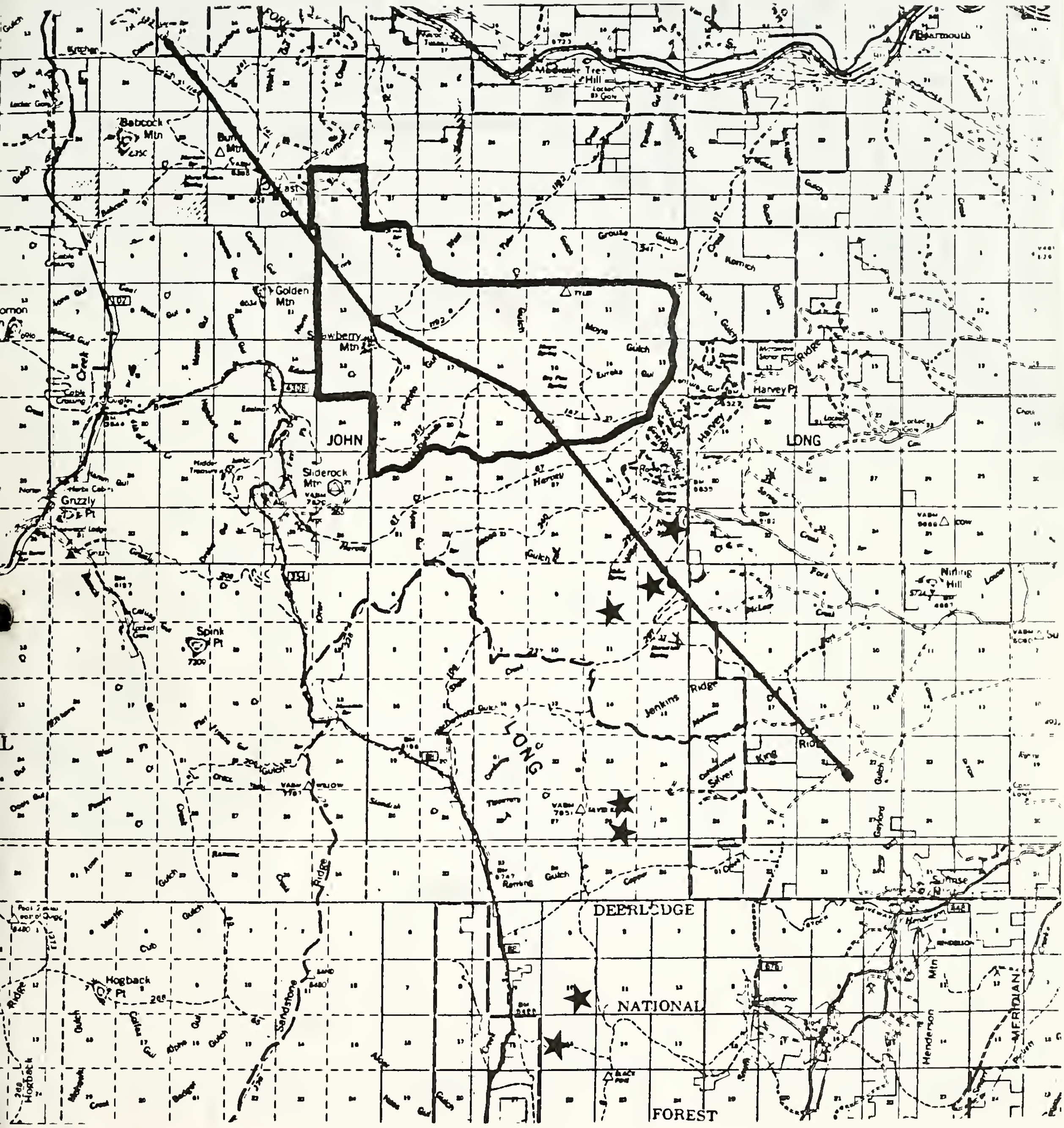
Relocations of six radioed elk periodically monitored in the Harvey-Eightmile area, Montana, from 8 April - 9 May, 1985. The powerline and study area boundary are also shown.



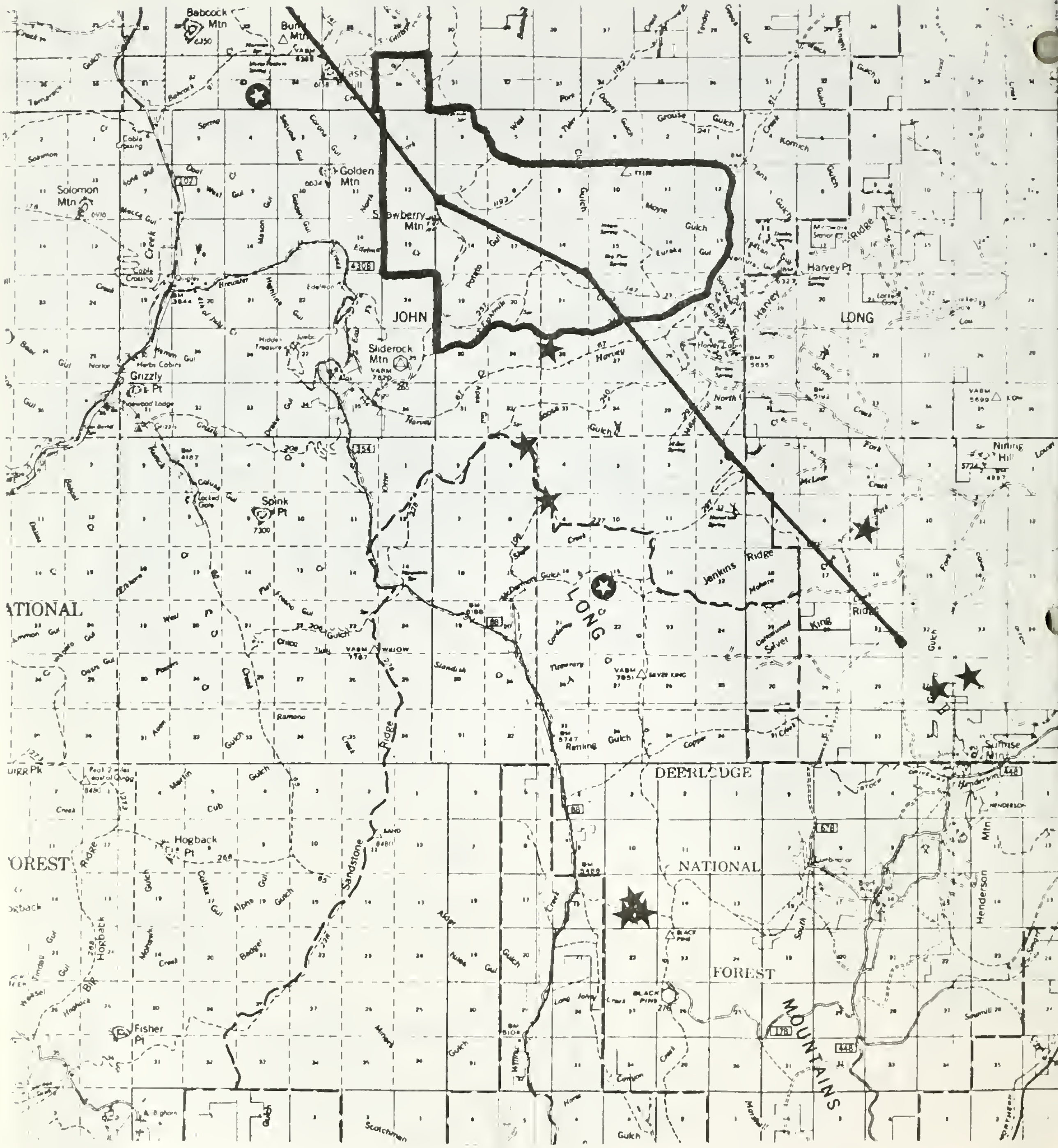
Relocations of five radioed female elk periodically monitored in the Harvey-Eightmile area, Montana, from 23 May - 19 June, 1985. The powerline and study area boundary are also shown.



Relocations of five radioed female elk monitored in the Harvey-Eightmile area, Montana from 15 July - 16 August, 1985. The powerline and study area boundary are also shown.

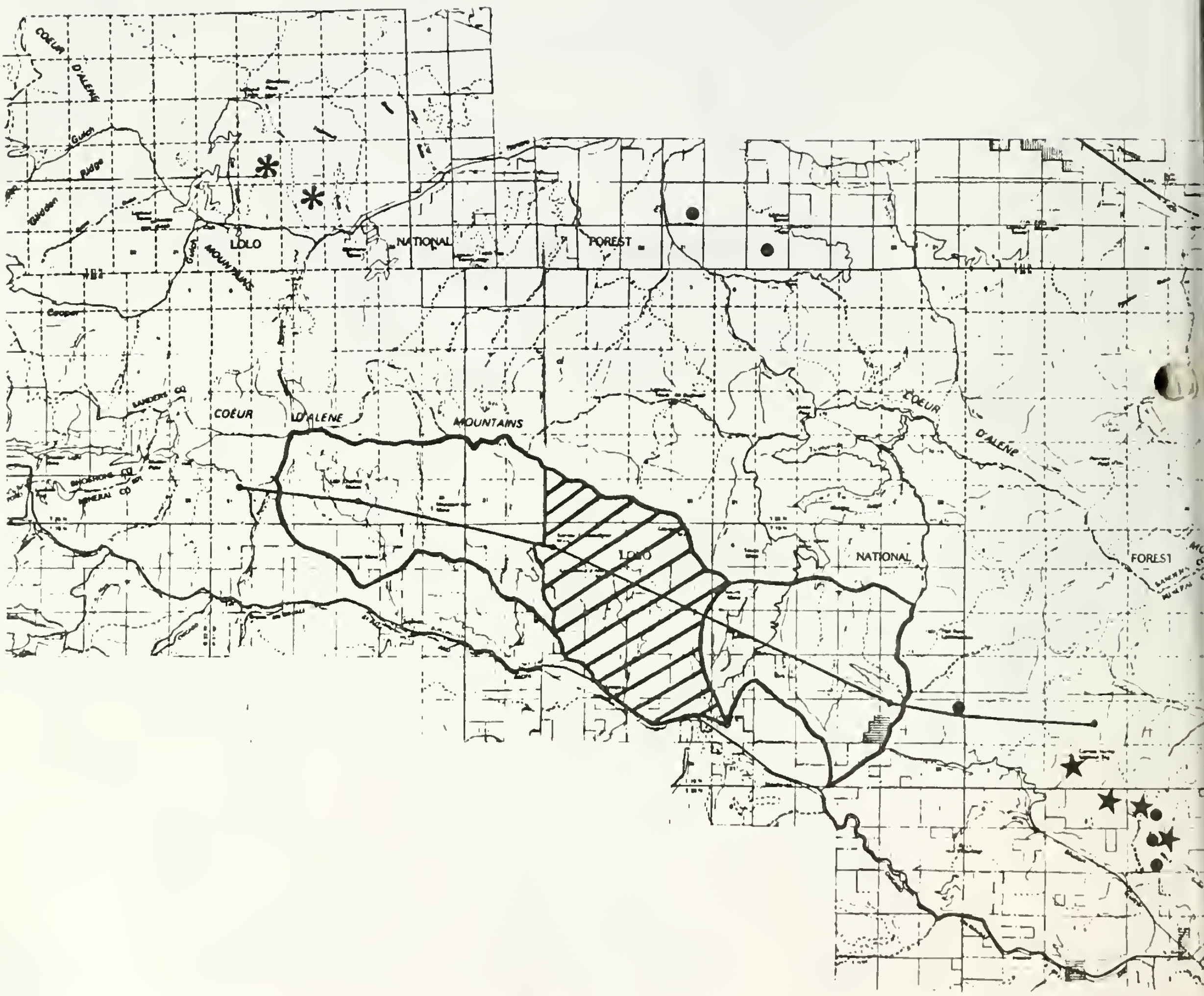


Relocations of four radioed female elk monitored in the Harvey-Eightmile area, Montana on 16 and 25 September 1985. The powerline and study area boundaries are also shown.

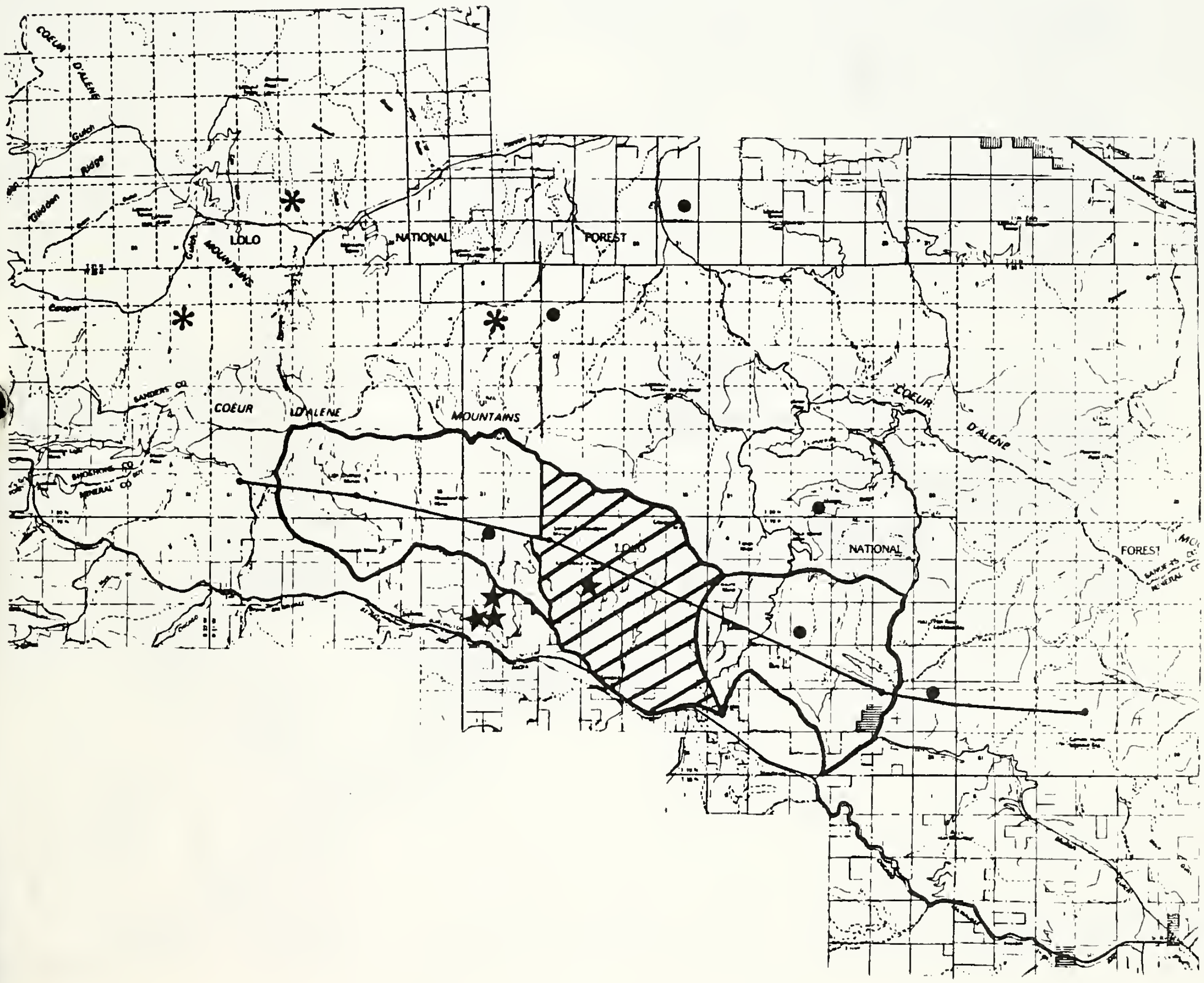


Relocations of three radioed female elk periodically monitored in the Harvey-Eightmile area, Montana, from 10 October - 10 December 1985. The powerline and study area boundary are also shown. The white stars depict December relocations.

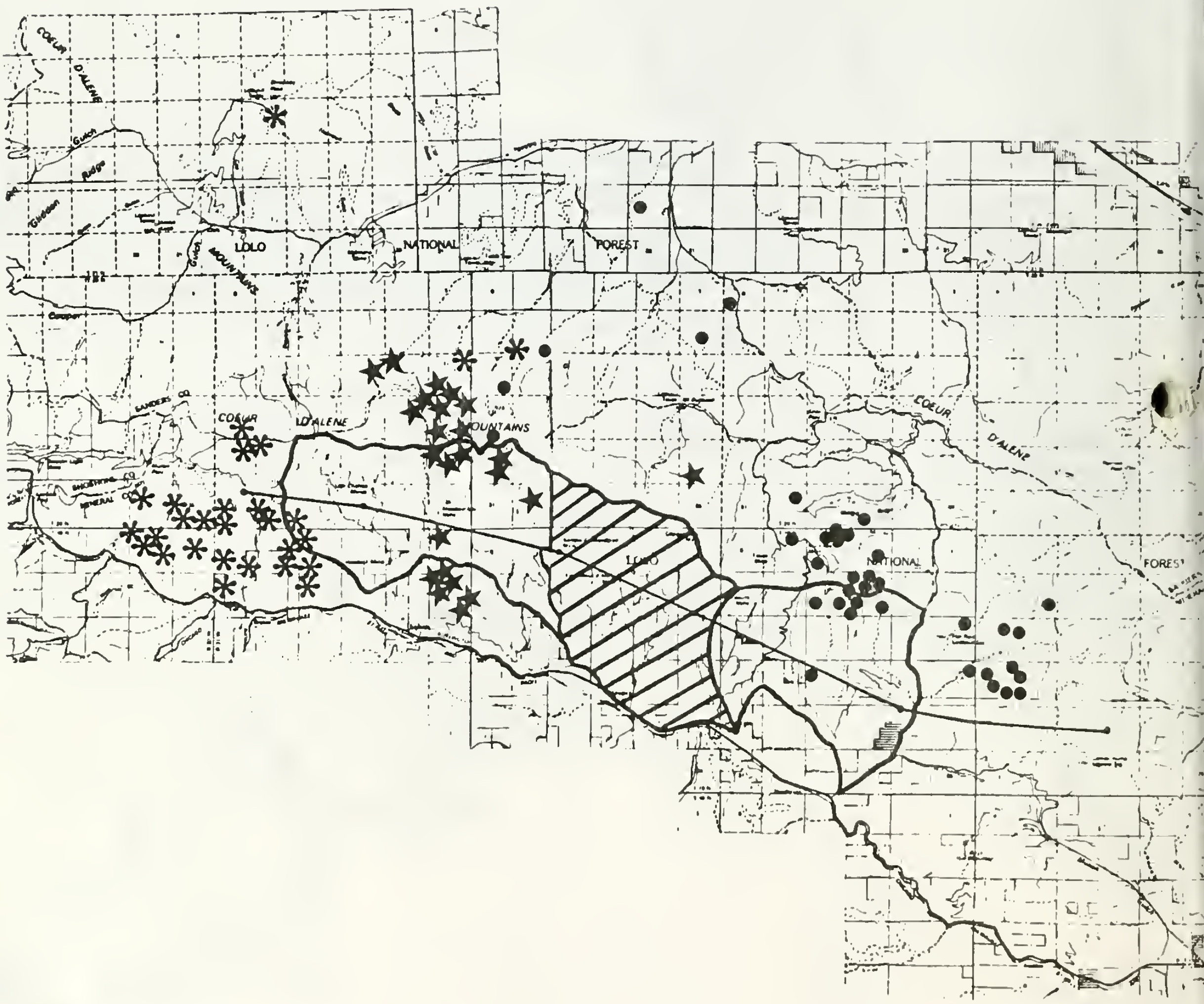
Appendix C - Relocation maps of radioed elk in the DeBorgia area, 1985.



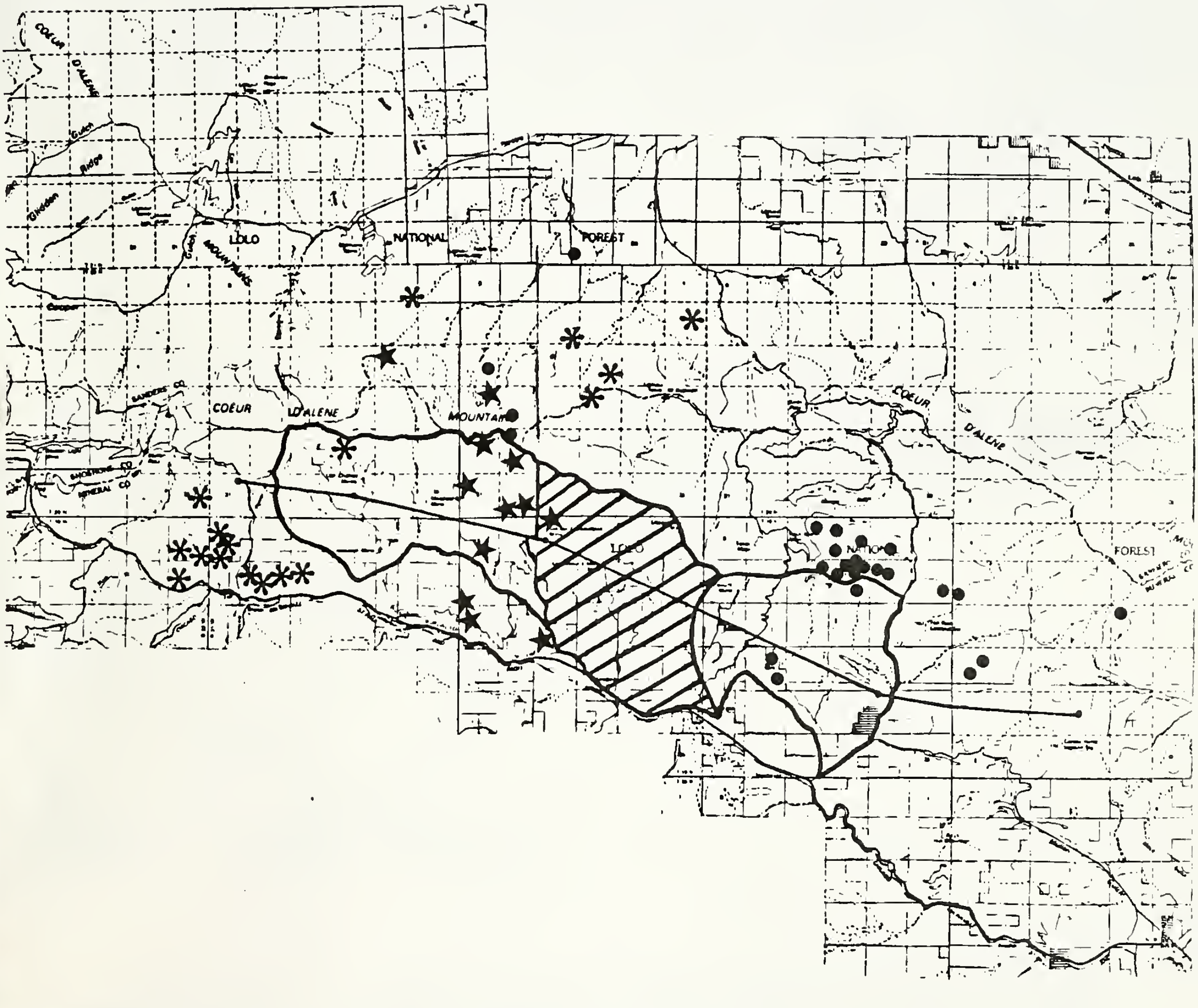
April 1985 relocations of six radioed elk near DeBorgia, Montana (asterisks, stars, and dots represent elk trapped at Randolph Creek, Meadow Mountain, and Rock Creek, respectively). The powerline and study area boundaries are also shown.



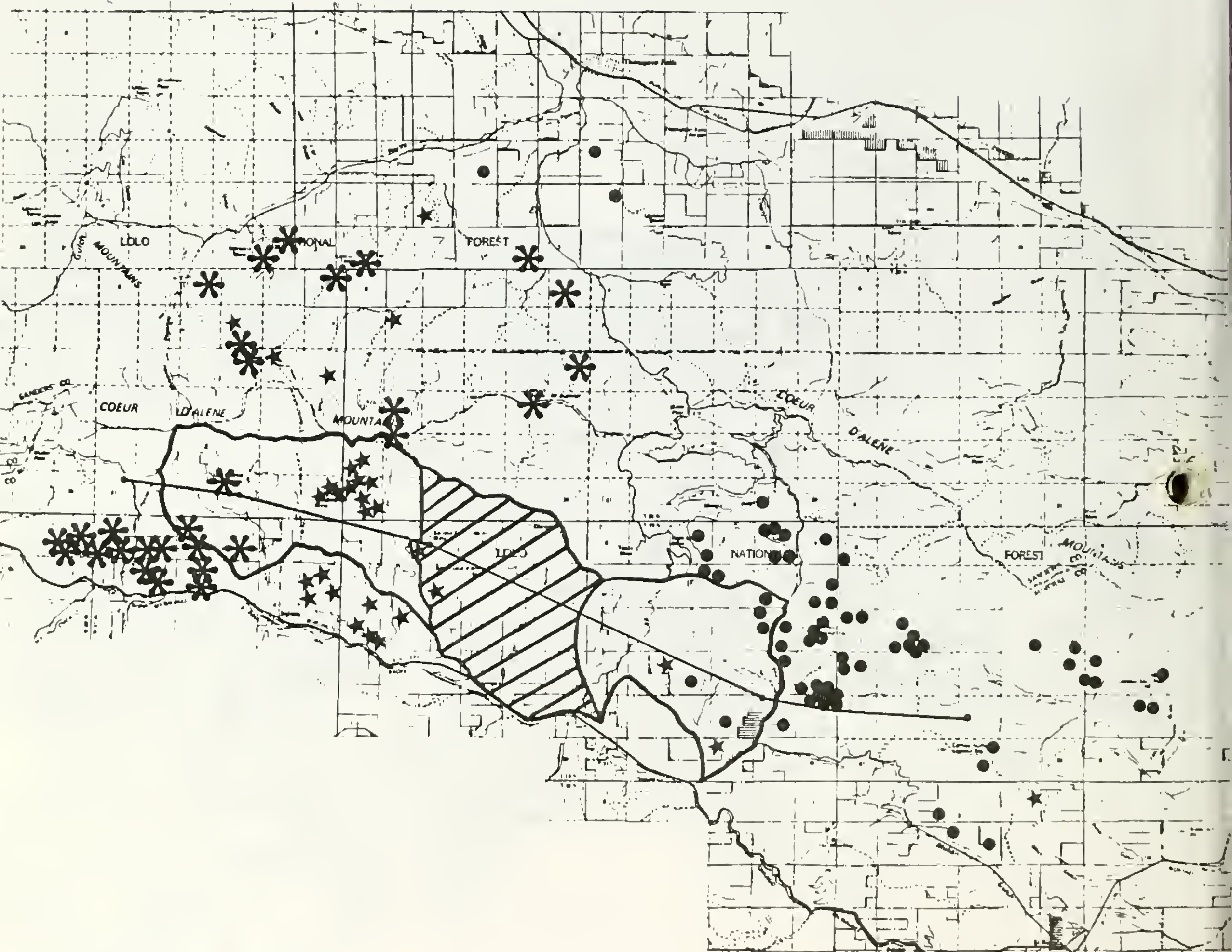
Relocations of six radioed elk near DeBorgia, Montana in May-June 1985 (asterisks, stars, and dots represent elk trapped at Randolph Creek, Meadow Mountain, and Rock Creek, respectively). The powerline and study area boundaries are also shown.



Ninety relocations of seventeen radio-equipped elk monitored periodically from 3 July - 30 August 1985 near DeBorgia, Montana. (Asterisks, stars, and dots represent elk trapped at Randolph Creek, Meadow Mountain, and Rock Creek, respectively). The powerline and study area boundaries are also shown.



Relocations of seventeen radio-equipped elk monitored periodically from 13 September - 30 September 1985 near DeBorgia, Montana. (Asterisks, stars, and dots represent elk trapped at Randolph Creek, Meadow Mountain, and Rock Creek, respectively). The powerline and study area boundaries are also shown.



Relocations of 17 radioed elk from 8 October - 5 December 1985 near DeBorgia, Montana. (Asterisks, stars, and dots represent elk trapped at Randolph Creek, Meadow Mountain, and Rock Creek, respectively). The powerline and study area boundaries are also shown.

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